



Department of Energy

Oak Ridge Operations
Weldon Spring Site
Remedial Action Project Office
7295 Highway 94 South
St. Charles, Missouri 63304

November 18, 1992

Mr. Dan Wall
Remedial Project Manager
U.S. Environmental Protection
Agency
Region VII
726 Minnesota Avenue
Kansas City, Kansas 66101

Dear Mr. Wall:

**SAMPLING PLAN FOR DETERMINATION OF HYDRAULIC PROPERTIES OF
UNDISTURBED SOILS IN THE WELDON SPRING DISPOSAL FACILITY STUDY
AREA**

Enclosed are 2 copies of the above sampling plan. Principal elements of this plan include two-stage borehole field permeability tests and triaxial permeability tests using synthesized leachate. These tests are being undertaken in response to MDNR comments on site suitability issues. Additional testing activities are proposed to obtain information to be used to resolve remedial design and performance assessment issues. Portions of this plan have been made available, in draft form, to MDNR-DGLS staff in order to facilitate the timely acquisition of this data.

If you have any questions, please feel free to contact me.

Sincerely,

A handwritten signature in cursive script, reading "Jerry S. Van Fossen".

Jerry S. Van Fossen
Deputy Project Manager
Weldon Spring Site
Remedial Action Project

Enclosure:
As stated

cc w/enclosure:
Dave Bedan, MDNR (5 copies)
Mary Gilbert, PMC

DOE/OR/21548-164

CONTRACT NO. DE-AC05-86OR21548

SAMPLING PLAN FOR DETERMINATION OF HYDRAULIC PROPERTIES OF UNDISTURBED SOILS IN THE WELDON SPRING DISPOSAL FACILITY STUDY AREA


Weldon Spring Site Remedial Action Project
Weldon Spring, Missouri

OCTOBER 1992

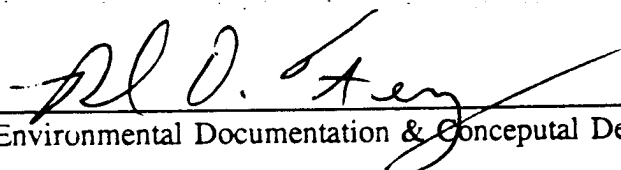
REV. 1



U.S. Department of Energy
Oak Ridge Operations Office
Weldon Spring Site Remedial Action Project

 MK-FERGUSON <small>A MORRISON KNUDSEN COMPANY</small>	Issue Date:
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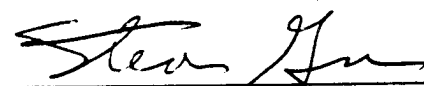
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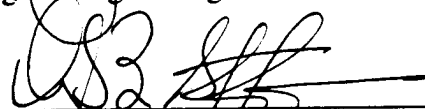
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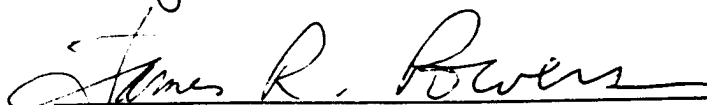
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 Engineering Manager

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 Deputy Project Director

10/19/92
 Date


 Project Director

10/19/92
 Date

Weldon Spring Site Remedial Action Project

**Sampling Plan for Determination of Hydraulic Properties of Undisturbed Soils in the
Weldon Spring Disposal Facility Study Area**

Revision 1

October 1992

Prepared by

**MK-FERGUSON COMPANY
and
JACOBS ENGINEERING GROUP
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St. Charles, Missouri 63304**

for the

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Oak Ridge Operations Office
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ABSTRACT

Sampling and testing is proposed to obtain information on the hydrologic properties of site soils within the disposal facility study area (DFSA). Sampling and testing will focus on assessing the effects of naturally occurring fractures and synthesized leachate on soil permeability. Proposed activities will also help satisfy location standards defined by the Missouri Code of State Regulations for proposed landfills. Proposed activities include testing, exploratory trenches and laboratory chemical and physical analyses.

Six geotechnical boreholes are proposed to obtain soil samples for determination of saturated and unsaturated hydraulic conductivity and associated properties.

Sixteen two-stage borehole tests at six locations and five largey diameter sealed-double ring infiltrometer tests at four locations are planned to obtain information on in situ permeability of unsaturated site soils.

Three exploratory trenches are planned to obtain information on perched water conditions within the DFSA.

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1 INTRODUCTION

This sampling plan has been developed to provide the U.S. Department of Energy (DOE) and the Missouri Department of Natural Resources (MDNR) with reliable and reproducible data on the hydraulic properties of unsaturated soils at the Weldon Spring site (WSS) in the area of the proposed disposal facility (DF). Sampling and testing will focus on assessing the effects of naturally occurring fractures and synthesized leachate on soil permeability. This plan supercedes proposed actions outlined in the *Disposal Facility Siting Demonstration Proposal* (MKF and JEG 1991a).

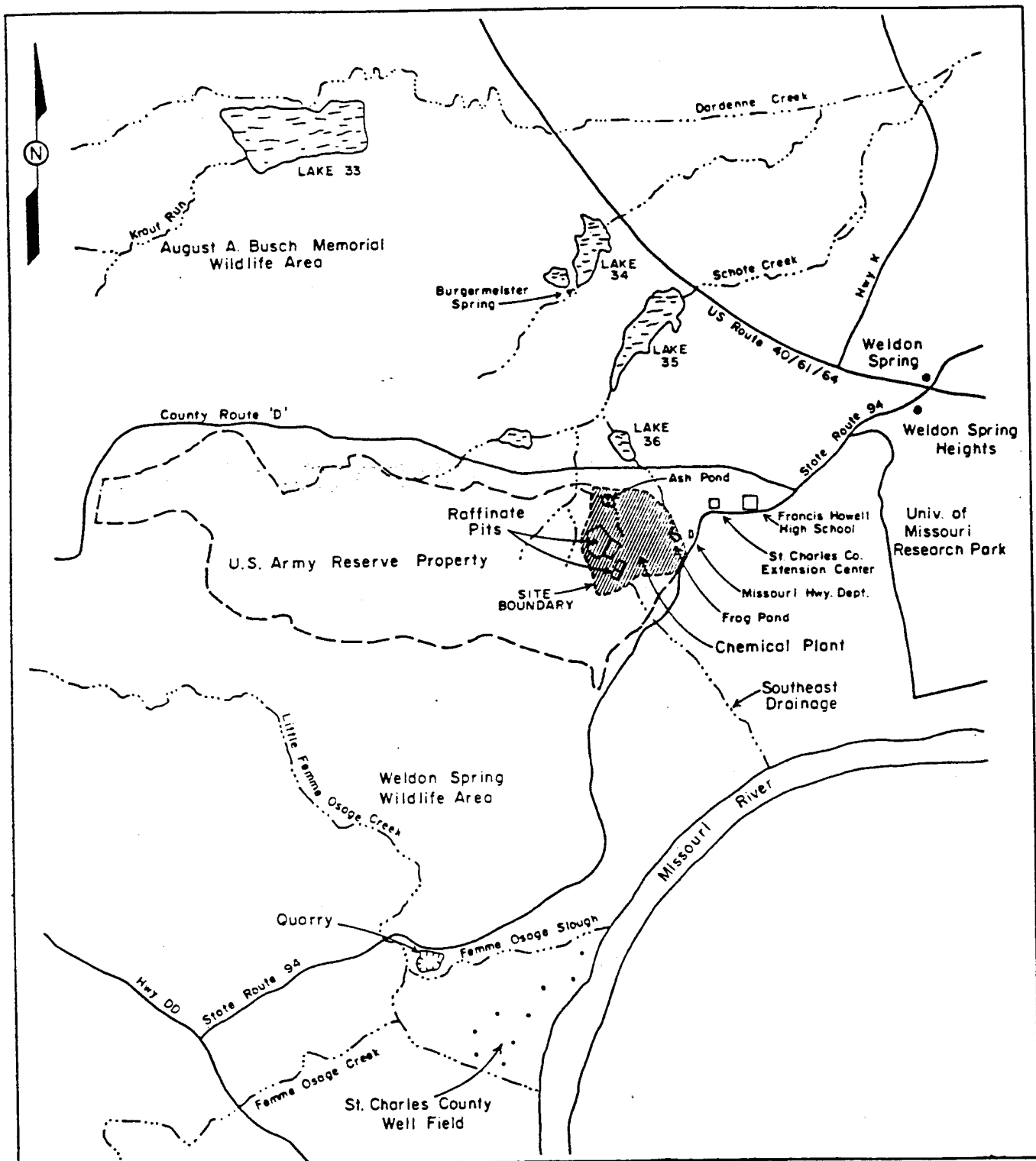
The WSS is a DOE surplus facility located in St. Charles County, Missouri (Figure 1-1). The site has been contaminated by trinitrotoluene (TNT) and dinitrotoluene (DNT) from past ordnance production activities and more recently by radionuclides and metals from the processing of uranium ore (MKF and JEG 1992a).

1.1 Purpose

The primary purpose of this investigation is to obtain representative soil samples of principal soil units beneath the proposed DF (Figure 1-2) and through laboratory analysis, determine their saturated and unsaturated hydraulic conductivity, the effect of leachate on soil permeability, and other hydraulic parameters. Fractures observed in the exposed glacial and post-glacial soils beneath the WSS are a concern to the State of Missouri and the DOE because of the effect these features might have on the hydraulic conductivity of the soils and the subsequent transport of leachate born contaminants.

This sampling program will also help satisfy design criteria for the cell foundation that are consistent with the Missouri Code of State Regulations 10 CSR 25-7.264(2)(N)1.A,B.

Zones within the overburden soils at the Weldon Spring Chemical Plant (WSCP) are considered to potentially contain perched groundwater. The remedial investigation report for the WSCP/Weldon Spring raffinate pits (WSCP/RP) areas summarizes the occurrence of perched water conditions known to exist at the site (MKF and JEG 1992a). Known areas of perched water are generally associated with seepage emanating from the raffinate pits. However, the site has been extensively reconfigured and differs from the topography that existed prior to development for the Weldon Spring Ordnance Works (WSOW). Therefore, it is reasonable to

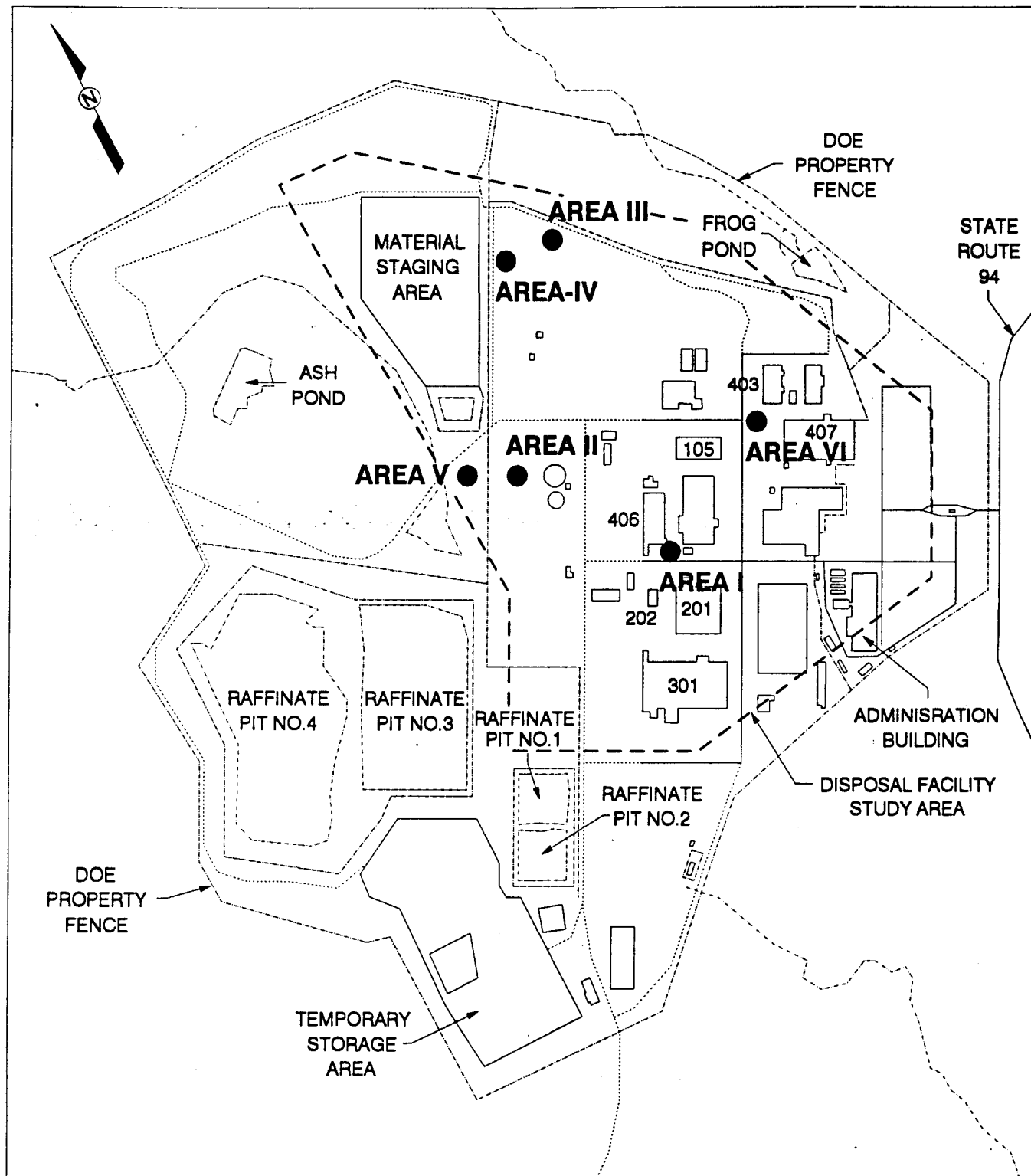


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WELDON SPRING SITE AND VICINITY

FIGURE 1-1

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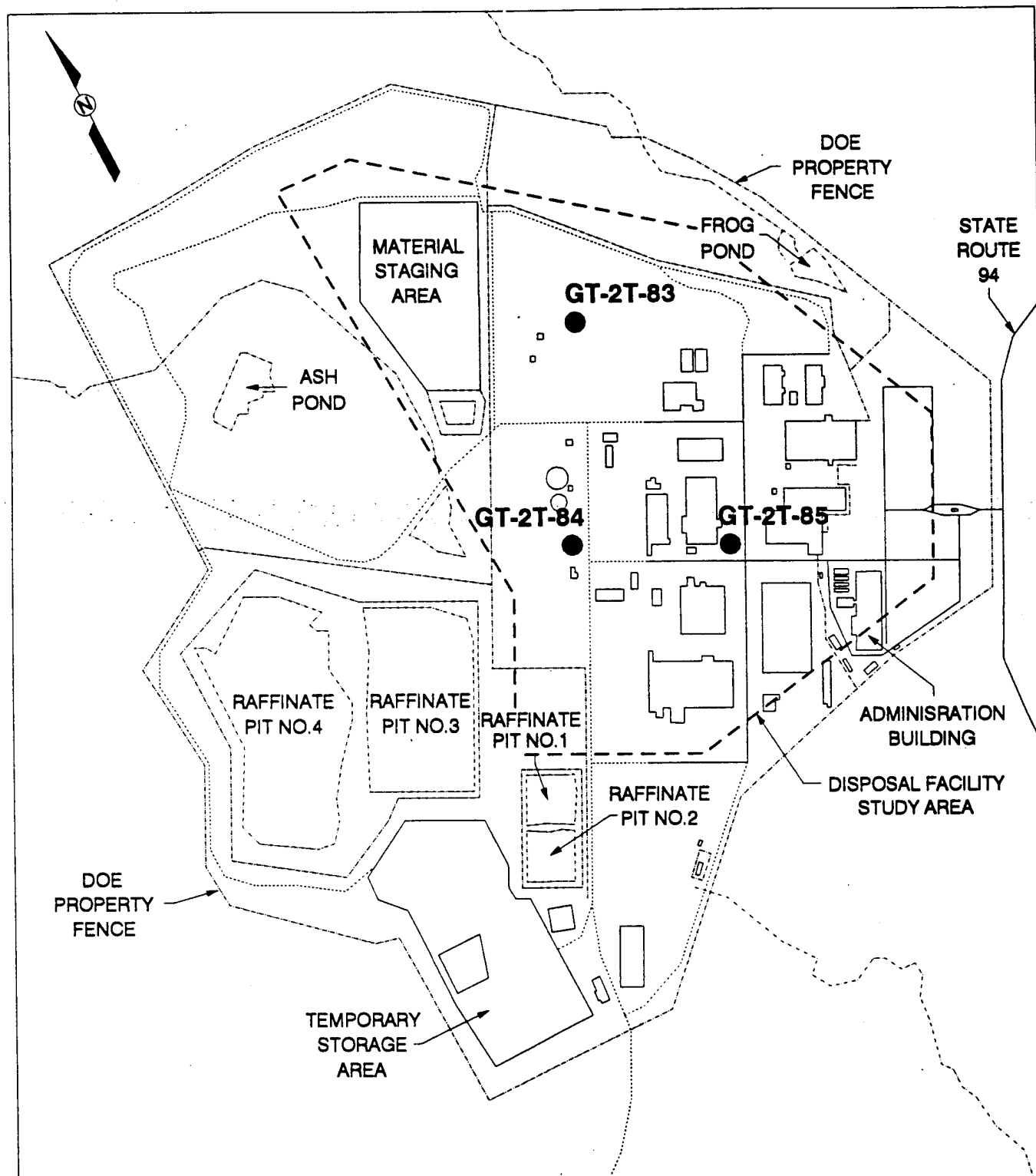
MAP OF THE WELDON SPRING CHEMICAL PLANT AREA SHOWING HYDRAULIC PROPERTIES SAMPLING LOCATIONS			
FIGURE 1-2			
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expect that pre-WSOW and pre-WSCP drainages actively transmit unsaturated flow at the fill and undisturbed soil interface. Organic soils may also be associated with perched water conditions. In order to facilitate the development a disposal cell foundation excavation plan, trenches will be excavated in locations specified as part of this plan to determine whether perched water or unsuitable soils are present. Figure 1-3 shows three trenches within the proposed DF footprint at locations of suspected seepages or perched water.

1.2 Scope

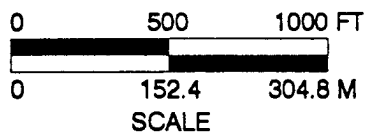
To determine the effects of fractures and other structures on soil permeabilities, field sealed double ring infiltrometer (SDRI) and two stage borehole (TSB) permeability tests (Boutwell 1992) of representative soil structures will be conducted in the proposed DF footprint. The permeability values obtained will be compared to those determined from laboratory techniques. Samples will be collected and tested as follows:

- Standard undisturbed samples (3-in. Shelby Tube type) will be collected for permeability test runs with both water and with a formulated leachate. Undisturbed and remolded samples from each unit of interest will be tested.
- Submersible pressure outflow cell (SPOC) tests will be run on standard-sized undisturbed samples to develop soil moisture retention curves. These curves will document the capillary retention properties of different units at varying temperatures. The saturated hydraulic conductivity will be determined directly from the tests; the unsaturated hydraulic conductivity will be calculated.
- General mechanical soil properties such as grain size distributions, Atterberg limits and specific gravities will also be determined from the standard size samples.
- Two stage borehole permeability (TSB) tests will be performed in the same locations and depths as the Ferrelview and clay till standard size samples.
- SDRI field tests will also be performed at the same locations and depths as noted above for laboratory testing and TSB tests.



LOCATION OF TRENCHES FOR
PERCHED WATER INVESTIGATION

FIGURE 1-3



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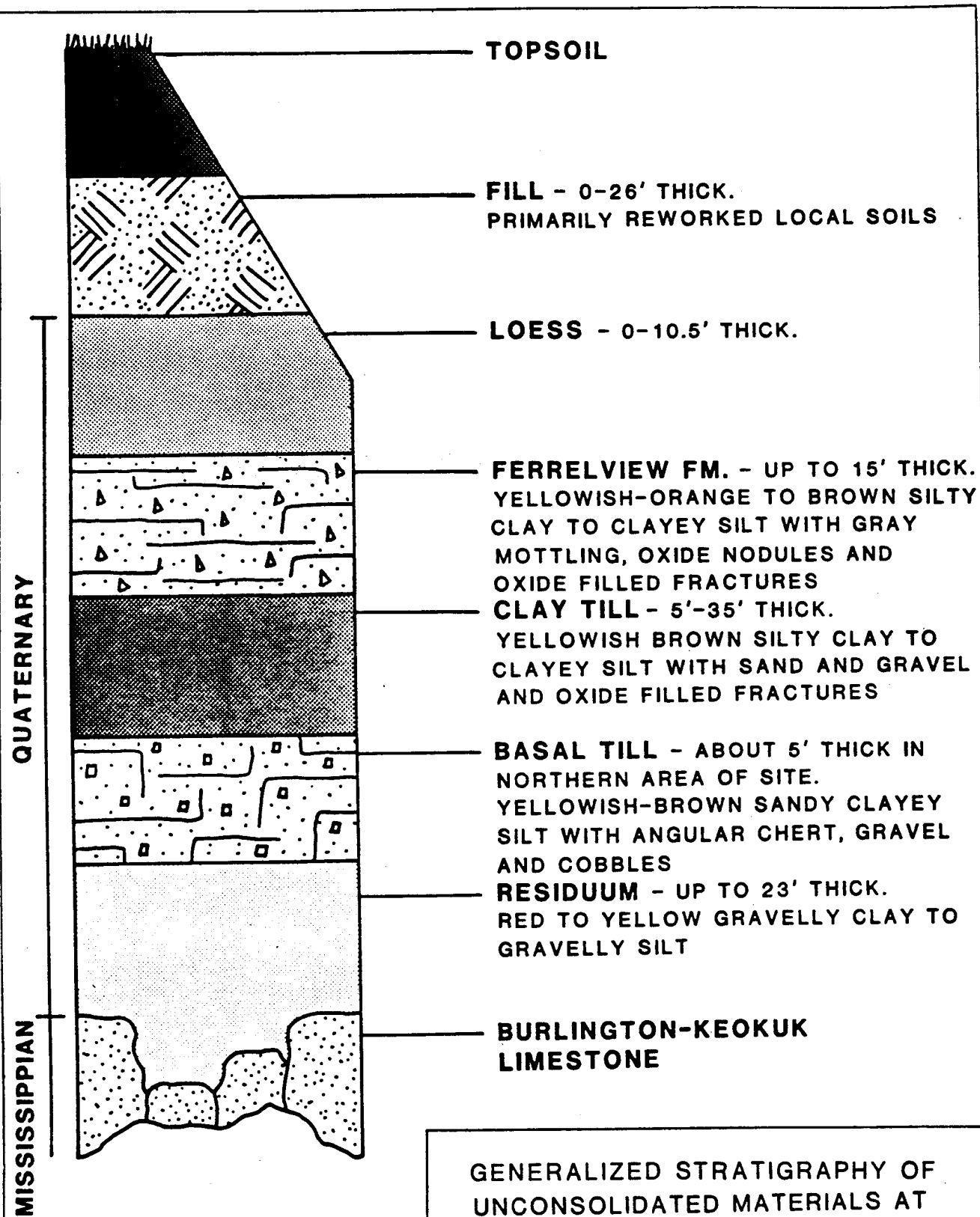
- Trenching will be performed to delineate and geotechnically characterize suspected seepages along backfilled former drainages at the WSS in the areas shown on Figure 1-3. Seepages occur at the contact of the old drainage surfaces and overlying fill.

1.3 Background

Past drilling and trenching programs at the WSS have delineated six principal soil units above the first bedrock unit. The Burlington-Keokuk Limestone is the first bedrock unit underlying the unconsolidated overburden (MKF and JEG 1992a). Figure 1-4 shows the generalized stratigraphy of the unconsolidated materials beneath the WSS (MKF and JEG 1990). The thickness of the unconsolidated material ranges from 15 ft to 40 ft beneath the WSS and is controlled by site development construction, surface erosional features, and bedrock topography. The unconsolidated material is generally thickest in the north-central portion of the site and becomes thinner toward the east.

In descending order, the six principal soil units are; the topsoil/fill unit, the loess unit, the Ferrelview Formation, the clay till unit, the basal till unit, and the residuum unit. The soil units of interest for the purposes of this investigation are the loess, Ferrelview Formation, and clay till units. The topsoil fill unit will be removed as part of the disposal facility foundation preparation. The basal till unit is thin and sporadically distributed under the site, and consequently this unit is not considered a good barrier to contaminant migration and will not be sampled. The residuum overlying the Burlington-Keokuk Limestone bedrock is highly heterogenous with significant percentages of coarse grained materials. It is not expected to retard contaminant migration to any significant extent. This unit will not be sampled or tested.

The upper Pleistocene loess unit underlies the topsoil/fill unit but is found mostly on hilltops (unless disturbed or removed by site construction activities). This unit is a windblown silt. It was affected by the topography at the time of its deposition and eroded from lower drainages by post-depositional stream action (MKF and JEG 1992a). The thickness of the loess varies from 0 ft to 10.5 ft across the site. The unit consists primarily of a silt to clayey silt with small amounts of sand. It has a low plasticity. The unit is the uppermost unit of interest with regard to permeability and other hydraulic properties.



GENERALIZED STRATIGRAPHY OF
UNCONSOLIDATED MATERIALS AT
THE WELDON SPRING SITE

FIGURE 1-4

NOT TO SCALE

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The Ferrelview Formation, another unit of interest for this investigation, is an interglacial deposit of mid-Pleistocene age, believed to have been deposited as a till plain sediment (Howe and Heim 1968). The transmissivity of these fractures and joints will be tested with samples obtained by this plan. Iron oxide nodules and conchoidal fracturing with slickensides are characteristic of this unit. Earlier particle size distribution laboratory testing of this unit has determined that it is primarily a silt to clay with small amounts of sand and fine gravel. Most particle sizes are less than 0.063 mm (0.002 in). The unit ranges from 0 ft to 22 ft in thickness across the site. A dark yellowish-orange to brown silty clay to clayey silt with gray mottling, this unit has joints or fractures, some of which contain secondary minerals such as pyrolusite.

The clay till unit underlies the Ferrelview Formation and is the most areally extensive overburden unit on the site. The clay till ranges in thickness from 0 ft to 30 ft and is found in almost all boreholes and trenches on site. This unit is a lower Pleistocene glacial till composed of yellowish brown silty clay and clayey silt. Pyrolusite as fracture coatings and nodules of iron oxide (limonite) are common. The unit is very stiff and moderately to highly plastic (MKF and JEG 1992a). The unit is characterized by pebbles of igneous and metamorphic origin. This soil unit is considered to have good potential as a barrier to leachate transport and will be sampled and tested in this investigation.

The basal till unit is the lowest member of the Pleistocene glacial sediments found on site. It underlies the clay till, reaching a maximum thickness of 5 ft in the area of Ash Pond and the western portion of the WSS. It is absent beneath the main portion of the WSS. It consists typically of yellowish-brown sandy, clayey silt with angular chert gravel and cobbles. The basal till will not be sampled in this investigation as it is too heterogenous, sporadic in distribution across the site, and too thin to rely on as a principal barrier unit with respect to leachate transport.

Modification of site topography for the Weldon Spring Ordnance Works, and later, the Weldon Spring Uranium Feed Materials Plant site development resulted in the placement of fill in natural surface drainages on the site. Infiltration and seepage from impoundments and leaky utilities on site has resulted in localized areas of saturated fill and topsoil within filled drainages. In some areas these conditions have resulted in a zone of perched water, while at other locations conditions may simply be characterized by porous fill or organic soil of a high moisture content. Section 2.4.2 of this sampling plan details plans to excavate trenches in locations suspected of containing perched water, or conducting seepage, within the Disposal Facility Study Area (Figure 1-3).

2 SAMPLE COLLECTION AND TESTING

2.1 Objective

The objective of this sampling plan is to provide representative undisturbed samples and field permeability test data necessary to determine the overburden permeabilities and hydraulic properties. Results of field and laboratory tests and field observations obtained from the implementation of this plan will be used in conjunction with the properties of engineered backfill to be placed as part of the cell foundation to achieve design criteria based on the state landfill location standards as defined under 10 CSR 25-7.264(2)(N)1.A,B.

2.2 Geotechnical Testing Requirements

The proposed laboratory testing program will follow American Society of Testing and Materials (ASTM), U.S. Army Corps of Engineers (COE), and U.S. Environmental Protection Agency (EPA SW-846) standards. Representative samples will be tested for general physical soil characteristics and engineering and hydrologic properties in order to characterize the ability of each overburden unit. General mechanical soil properties of interest include specific gravity, size gradation, soil classification, natural moisture, and dry density. Engineering properties include unconsolidated undrained triaxial compression and consolidated undrained triaxial compression tests.

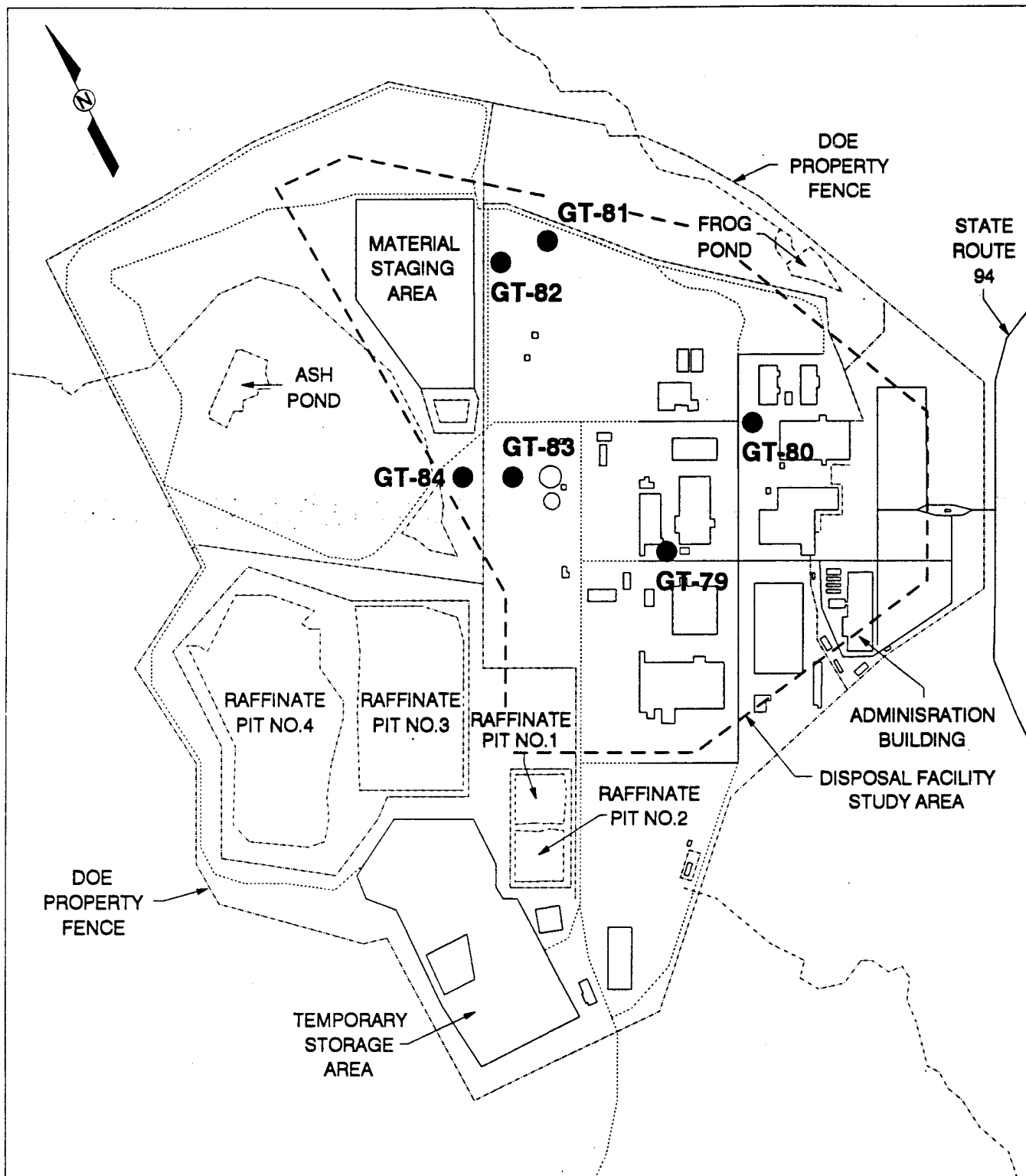
Table 2-1 lists the test methods, hydraulic properties of interest, and the sample type to be submitted for each test (ASTM standards were used unless a COE or EPA standard was preferred). Tests for which a standard has not been developed will be described in detail in the specifications for that phase of the study. Undisturbed and recompacted samples will be obtained by hollow stem augering and pushing Shelby (thin-walled) sample tubes. Leachate developed on site from cement stabilized/solidified material and soil will be used to test leachate constituent effects on the permeability of these samples.

Figure 2-1 shows the locations of, and numbering system for, the hydraulic properties samples (locations correspond to the areas of Figure 1-2). These samples will be taken prior to carrying out the sealed double ring infiltrometer (SDRI) and the two stage borehole (TSB) test programs. The boreholes will be used to further define the units prior to locating the in situ tests.

TABLE 2-1 List of Laboratory Hydraulic Tests

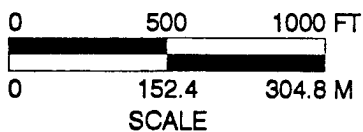
Soil Property (Test Method) Soil Unit	Sample Type		
	SDRI/TSB Support Undisturbed	Undisturbed	Recompacted
Moisture content (ASTM D2216) or Bush & Jenkins (1970) method:			
Loess Soil	-	3	-
Ferrelview Formation	4	9	-
Clay Till	3	9	-
Specific gravity and porosity (ASTM D854) or calculated from SPOC test:			
Loess Soil	-	3	-
Ferrelview Formation	4	9	-
Clay Till	3	9	-
Bulk soil density (ASTM D2937 or D1587-83) soil classification (ASTM D2487-90) and Atterbergs (ASTM D4318-84) (Includes tests for 12 TSBs):			
Loess Soil	-	3	-
Ferrelview Formation	4	15	-
Clay Till	3	15	-
Saturated hydraulic conductivity with water and leachate (EPA SW-846 Method 9100, or EM 1110-2-1906, Appendix VII, COE 1970):			
Loess Soil	-	1	1
Ferrelview Formation	-	6	1
Clay Till	-	6	1
Saturated hydraulic conductivity with water using Triaxial Cell Flexible Wall Permeameter (ASTM D5084):			
Loess Soil	-	2	-
Ferrelview Formation	4	6	-
Clay Till	3	6	-
Triaxial shear strength (ASTM D4767 or EM-1906, Appendix X, COE 1970):			
Loess Soil	-		
Ferrelview Formation	-	3CU, 3UU	1CU, 1UU
Clay Till	-	3CU, 3UU	---, ---
Soil water retention characteristics (SPOC Test Constanz and Herkelrath 1984):			
Loess Soil	-	3	
Ferrelview Formation	4	9	
Clay Till	3	9	
Saturated hydraulic conductivity with water, (EM 1110-2-1906, Appendix VII, COE 1970):			
Loess Soil	-	-	-
Ferrelview Formation	4	-	-
Clay Till	3	-	-

CU Confined undrained
UU Unconfined Undrained
- Not tested



SMALL DIAMETER GEOTECHNICAL BOREHOLES LOCATION MAP

FIGURE 2-1



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The current disposal facility construction plan does not use the loess soils for any structural load bearing fill. However, it is possible that some of this unit may unavoidably be incorporated into the facility's subgrade. Therefore, the hydraulic properties of the loess in both disturbed (recompacted-remolded) and undisturbed samples should be tested (MKF and JEG 1991a). On the other hand, the small volumes of loess soils relative to the Ferrelview Formation and clay till require only the minimum number of triaxial shear strength tests on this unit (Table 2-1). Field testing of the loess unit by either the TSB or the SDRI methods will not be necessary as these tests are for undisturbed, in situ conditions. During disposal facility (DF) construction, any suitable loess material present in the cell footprint will be excavated, mixed with other low permeability soil types, and recompacted.

The Ferrelview Formation and the underlying clay till all have a significant impact on the DF as leachate transport barrier units. These units will be tested for the effect of leachate on their permeabilities and shear strengths as undisturbed soil units (Table 2-1). The current construction plan for the DF will not disturb significant volumes of the underlying clay till unit, so this unit will not be tested for either remolded (disturbed) triaxial shear strength or remolded hydraulic conductivity parameters.

Table 2-2 lists the laboratory tests in support of the SDRI program. Individual SDRIs will be installed at four of the six areas. Areas I and II will not have any SDRIs installed. They will, however, have two each of the two stage borehole (TSB) permeameters installed. At each site, one TSB will be installed in the Ferrelview and one in the clay till. One Shelby Tube sample will be obtained for general engineering soil classification parameters from each TSB site.

The SDRIs will be constructed and maintained according to test plans and specifications specifically developed for the WSSRAP by D.B. Stephens & Associates (DBS&A) (1991). Figures 2-2 and 2-3 list locations and designations of the SDRI and TSB installations, respectively. Site Areas III and IV will be the locations for SDRI installations FP-01 and FP-02 (Figure 2-2), both installed in the clay till unit (Table 2-2).

Area V will have a duplicate set of SDRIs installed, one in the upper Ferrelview Formation (FP-03) and one in the lower Ferrelview (FP-04). A TSB will be installed near each SDRI to the same approximate depth. The purpose of these duplicate field permeameter installations is to determine to what degree the Ferrelview varies in permeability with depth.

TABLE 2-2 List of Field Tests and Supporting Samples

Test Area	SDRI No.	Soil Unit	TSB No.	Pre-Test ^(a) SDRI Samples for Soil Hydr. Prop.	SDRI Post-Test Soil Samples for Moisture and Bt
I		Ferrelview	TSB 1	---	---
		Clay Till	TSB 2	---	---
II		Ferrelview	TSB 3	---	---
		Clay Till	TSB 4	---	---
III	FP-01	Clay Till	TSB 5	2 ^(b)	12 ^(c) 12
		Ferrelview	TSB 6		
IV	FP-02	Clay Till	TSB 7	1	12 12
		Ferrelview	TSB 8		
V	FP-03 ^(d)	Ferrelview	TSB 9	1	12 12
	FP-04 ^(e)	Ferrelview	TSB 10	2 ^(b)	12 12
		Clay Till	TSB 11		
VI	FP-05	Ferrelview	TSB 12	1	12 12
		Clay Till	TSB 13		
Totals	5		13	7	60 60

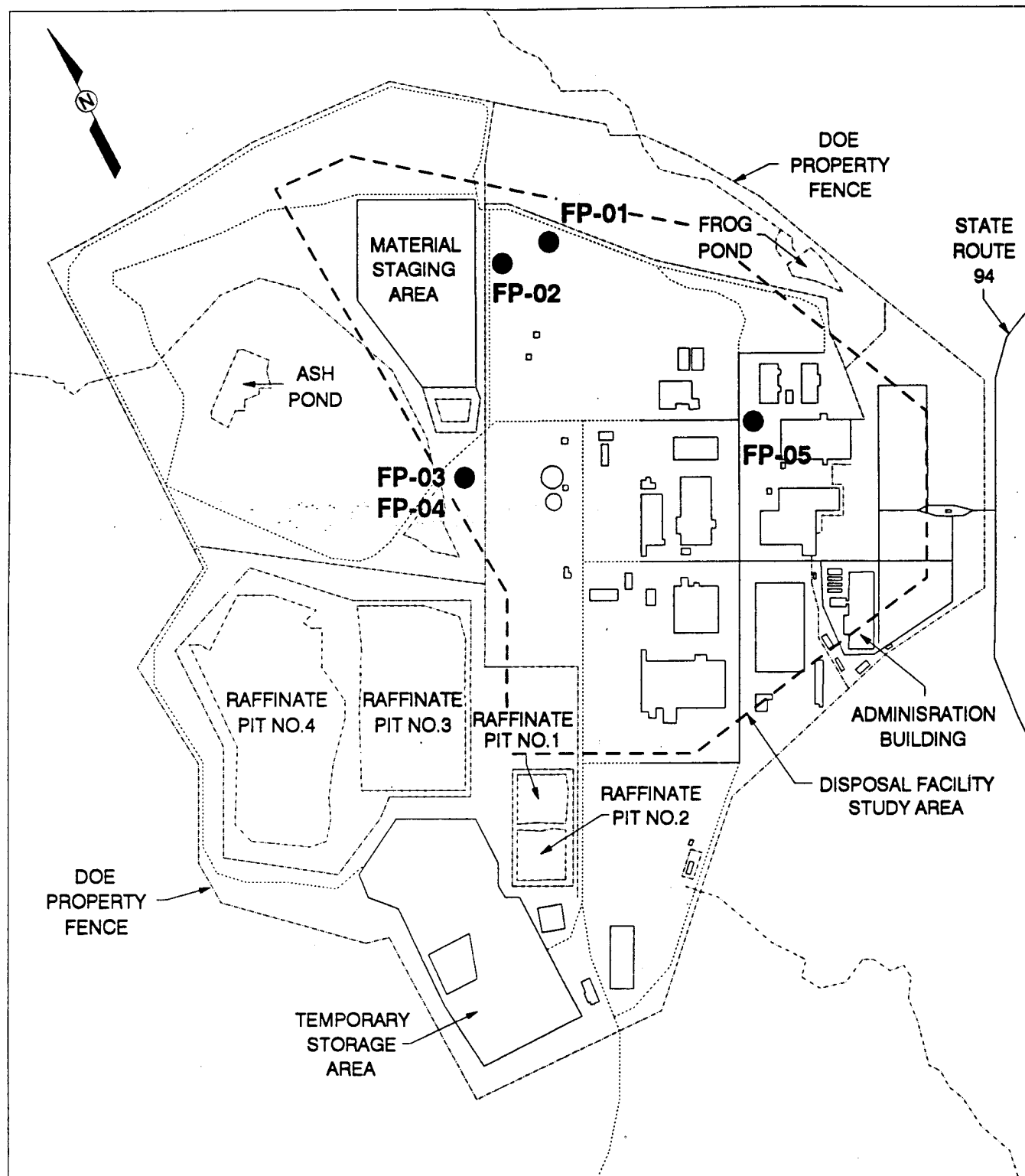
(a) Prior to running SDRIs, soil hydraulic property tests are those listed in Table 2-3.

(b) Duplicate soil samples for laboratory testing of hydraulic parameters at these locations.

(c) Estimated for 6 in. long samples taken continuously to bottom of wetting front (6 foot maximum depth).

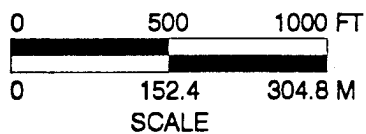
(d) FP-03 will be constructed in the shallow portion of the Ferrelview Formation.

(e) FP-04 will be constructed in the deeper Ferrelview Formation.



SEALED DOUBLE RING INFILTROMETER (SDRI) TEST PADS LOCATION MAP

FIGURE 2-2



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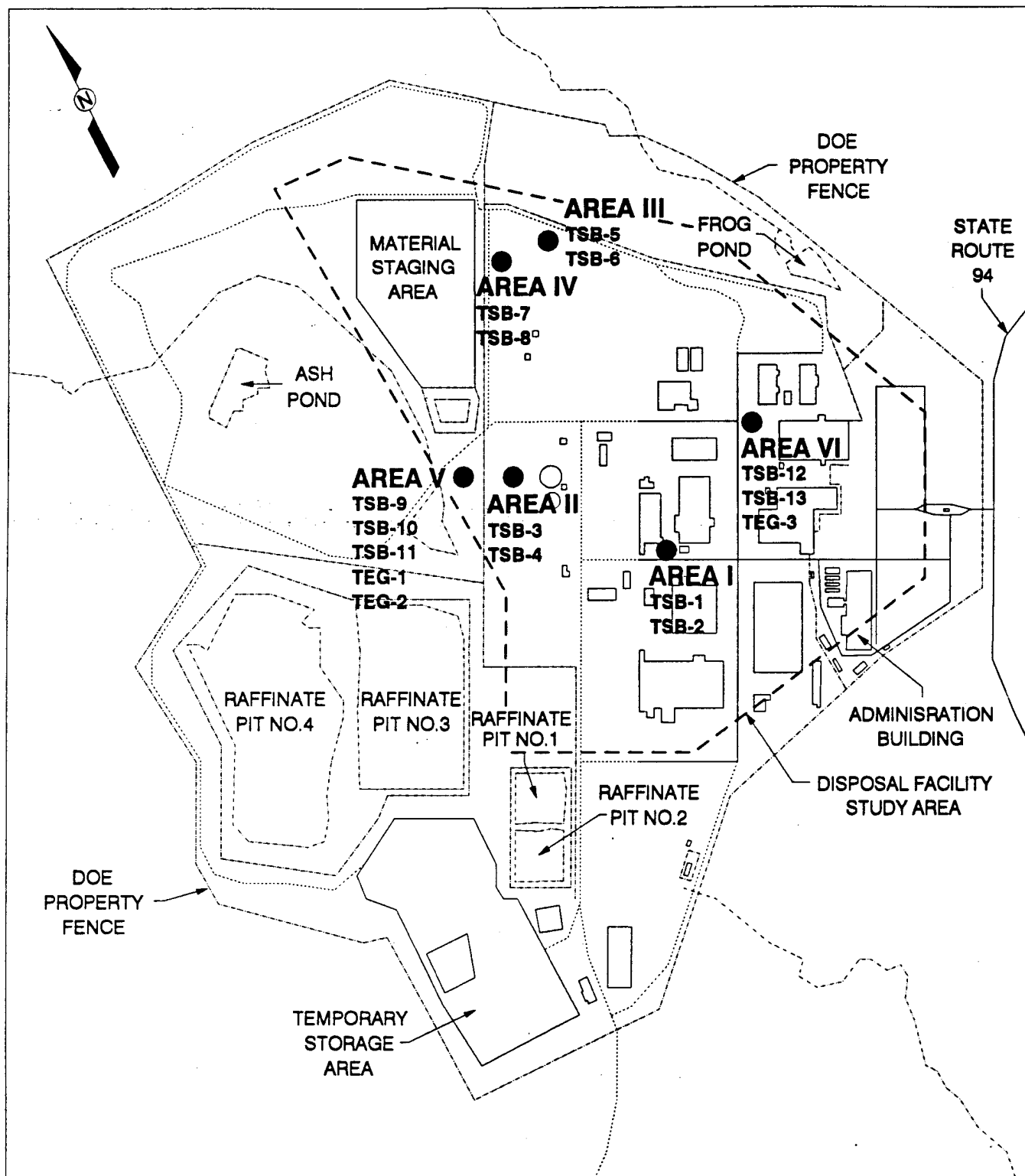
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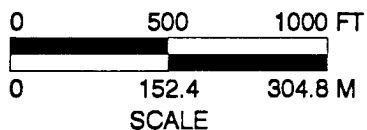
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TWO-STAGE BOREHOLE (TSB) PERMEABILITY TESTS LOCATION MAP

FIGURE 2-3



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Area VI will have one SDRI, FP-05 and two TSBs (Figures 2-2 and 2-3). One of the TSBs and the SDRI will be installed to test Ferrelview Formation. The remaining TSB will be installed to test the clay till at this location.

Each SDRI installation requires that initial, pre-test soil samples be taken (Table 2-2) for laboratory measurement of hydraulic soil properties. Table 2-3, as modified from DBS&A (1991), lists the specific test methods that should be followed in testing these pre-SDRI test samples. The number of tests required are included in the totals of Table 2-1. One sample for each soil type and location should be obtained. As shown on Table 2-2, two sets of duplicate soil samples will be obtained and tested for the complete set of hydraulic parameters as listed on Table 2-3. One set of duplicate soil samples will be for the Ferrelview Formation (potentially obtained from SDRI installation site FP-04, refer to Figure 2-2 for locations). The other set of duplicate soil samples will be for the clay till (potentially obtained from SDRI installation FP-01).

Post-test wetting front determination for the SDRI test is obtained by taking continuous thin wall tube samples from trenches excavated through the dismantled SDRI sites. The procedure for excavating the trenches, pushing the thin-walled samples, and ultimate wetting-front depth determination is detailed in DBS&A (1991) Sections 3.7, 3.8, and 3.9.

2.3 Sampling/Testing Locations and Identification

Sampling/testing locations are shown on Figure 1-2 as Areas I through VI. These locations were selected based on the following criteria.

- Minimum potential for future disturbance due to excavation of building foundations, underground utilities, or fill.
- Availability of the Ferrelview Formation and clay till unit.
- Easy access for sampling and testing equipment such as drilling rigs, backhoes, and infiltrometers.

The use of these criteria resulted in multiple sampling/testing locations in the northern portion of the disposal facility study area (DFSA) and a lack of locations in the southern portion

TABLE 2-3 Summary of Recommended Methods for Laboratory Hydraulic Parameter Testing of Soils at SDRI Sites

Hydraulic Parameter To Be Measured	Recommended Method
1. Soil-Moisture Retention Characteristics ^(a)	1. SPOC Test
2. Saturated Hydraulic Conductivity Using Flexible Membrane or Triaxial Cells	2. ASTM D 5084-91
3. Saturated Hydraulic Conductivity in Thin-Walled Sample Tubes	3. Engineer Manual, 1980, Laboratory Testing of Soils, U.S. Dept. of Army, Office of Chief Engineer, Washington, D.C., Publication No. 1110-2-1906, Appendix VII, pp. 16-17.
4. Unsaturated Hydraulic Conductivity (Calculated)	4. van Genuchten, M., 1980, A Closed Form Equation for Predicting the Hydraulic Conductivity of Unsaturated Soils, Soil Sci. Soc. Am. J., v. 44, pp. 892-898.
5. Volumetric Water Content ^(b)	5. Bush, D.C., and R.E. Jenkins, 1970 (July), Proper Hydration of Clays for Rock Property Determinations, Journal of Petroleum Technology, pp. 900-904.
6. Bulk Density	6. Blake, G.R., and K.H. Hartge, 1986, Bulk Density, <i>In</i> Methods of Soil Analysis, Part I, Klute (ed.), American Soc. of Agronomy, Madison, WI, Chapter 13, pp. 363-367.
7. Porosity (Calculated)	7. Danielson, R.E. and P.L. Sutherland, 1986, Porosity <i>In</i> Methods of Soil Analysis, Part I, Klute (ed.), American Soc. of Agronomy, Madison, WI, Chapter 18, pp. 444-445.

Table is modified from D.B. Stephens & Associates, Inc. 1991.

^(a) The Submerged pressure outflow cell (SPOC) method of Constantz and Herkelrath (1984) yields saturated and unsaturated hydraulic conductivity of soil specimens in the same apparatus. It is used here in lieu of ASTM moisture retention characteristics test methods D2325-68 and D3152-72.

^(b) As recommended by D.B. Stephens & Associates 1991.

of the DFSA. This is because the units of interest are not easily accessible in the south and site remediation activities involving building demolition, foundation removal, fill removal, and contaminated soil removal will result in intense modification of surficial soils in the southern portion of the DFSA.

2.3.1 Area I

Sample Area I is in an open, grassy area, between chemical plant (CP) Building 202 and the main east-west site access road (Figure 1-2). The area is located on the south side of the road, across from CP Building 406, on a corner formed by the east-west access road and a deadend driveway that leads south to Buildings 201 and 301. The area is easily accessed by both these roadways. This location is near the center of the proposed DF's southern portion.

As shown on the logs of the three closest geotechnical boreholes (Appendix B, Figures B-2, B-3, and B-4), sporadic loess deposits of 0 ft to 3 ft in thickness may be encountered upon drilling in this area. The loess overlies between 7.5 ft to 17 ft of Ferrelview Formation (between 3 ft and 17.5 ft in depth). The Ferrelview overlies 10 ft to 20 ft of clay till, encountered at depths of between 15 ft to 20 ft. Appendix B, Figure B-1, summarizes symbols and designations used in geotechnical boring logs.

Area I will be the location for two TSB permeability tests. Table 2-2 lists the TSB and SDRI test sites, and the number and type of related soil samples. One TSB test will be conducted in the Ferrelview Formation and a second TSB test will be conducted in the clay till unit.

2.3.2 Area II

Area II is approximately 570 ft west and north of the first sample area, located just west of a large storage tank and the CP water tower. It also lies in an open area accessible from the east-west site access road. A source of subsurface control for this site includes test pit excavation GT-2T78 and geotechnical borehole log GT-53 (Appendix B, Figures B-5 and B-6). On the basis of this information, it is expected that 1 ft to 4 ft of topsoil, 1 ft to 2 ft of loess, 6 ft to 7 ft of Ferrelview Formation, 12 ft of clay till, and 1 ft to 2 ft of basal till will be encountered in this area. Two TSB permeability tests will be carried out at this site, one each in the Ferrelview and clay till soil units (Table 2-2).

2.3.3 Area III and IV

Areas III and IV are located 1,000 ft and 900 ft, respectively, to the north and west of Areas I and II (Figure 1-2). Area III is at a lower elevation than the other areas, located just east of, and adjacent to, a drainage channel that flows north-northeast through the site. Area IV is just east of the material staging area (MSA) and adjacent to a roadway that runs north around the CP perimeter.

In Area III, the logs for G-7, T-6, GMW-9 (MW-2009), GT-42, and GT-69 (Appendix B, Figures B-7, B-8, B-9, B-10, and B-11) all indicate the presence of 0 ft to 2 ft of topsoil/fill overlying anywhere from 0 ft to 11 ft of Ferrelview Formation and loess soil (from 0.5 ft to 11.5 ft depth) in turn overlying 9 ft to 11 ft of clay till (from 1.5 ft to 20.5 ft in depth). The clay till increases in thickness to the west, in the direction of Area IV. One SDRI test and one TSB test will be conducted at the 8 ft depth in the clay till at this location. If a thickness of 5 ft or more the Ferrelview Formation is present, it will also be tested with the TSB method.

Area IV thicknesses are based on the logs of borings GMW-9 (Appendix B, Figure B-9), G-3 (Appendix B, Figure B-12) and GT-42 (also designated GT-2B42) (Appendix B, Figure B-10). The logs indicate a sequence of 0.5 ft to 4 ft of gravel fill overlying 6 ft to 11 ft of Ferrelview and 24 ft or more of clay till (beginning at 6 ft in depth and extending down to between 20.5 ft and 31 ft). Possible loess soil deposits could exist in this area within the upper 10 ft (see log GMW-9). This location will have a single SDRI installed in the clay till at approximately the 8 ft depth. Two TSB tests will be run at this location, one in the Ferrelview Formation, at an estimated depth of 5 ft, and one in the clay till unit at a depth of 8 ft (Table 2-2).

2.3.4 Area V

Area V is located just south of the MSA and east of the Ash Pond, near the intersection of two site roads, the Patrol Road that runs north-south and the Ash Pond Road (Figure 1-2). Geologic logs G-5, G-6, and GT-61 (Appendix B, Figures B-13, B-14, and B-15) indicate up to 14 ft of Ferrelview Formation, either exposed at the surface or overlain by 1 ft of fill; and 10 ft of clay till from approximately 14 ft to 24 ft in depth. Loess soil may or may not be present at this site as it appears from 2 ft to 5 ft in depth at GT-61, but is not reported on logs G-5 and G-6.

This area will be the site for two SDRI installations, one in the upper Ferrelview Formation approximately 2 ft in depth, and one in the lower Ferrelview at 10 ft in depth (Table 2-2). Three TSB tests will be run at this site. One TSB corresponding to each of the two SDRIs will be installed in the upper and lower Ferrelview. A single TSB test will be conducted within the clay till at this location (Table 2-2).

2.3.5 Area VI

Area VI is located at the northwest corner of the No. 407 Building Block, across the street from Building 105, to the west, and Building 403, to the north (Figure 1-2). Based on geologic logs G-8 and GT-55 (GT-2B55) (Appendix B, Figures B-16 and B-17), up to 6 ft of fill overlies 3 ft to 4 ft of loess (from 6 ft to 10 ft in depth). In turn, the loess overlies 6 ft to 10 ft of Ferrelview Formation (9 ft to 20 ft in depth) and 7 ft to 11 ft of clay till (from 15 ft to 27 ft in depth).

Area VI will be the location of a single SDRI test, constructed in the upper Ferrelview Formation at an estimated depth of 10 ft. Two TSBs will be run at this location; one at the same depth of Ferrelview as the SDRI, and a second one in the clay till unit at an estimated depth of 16 ft (Table 2-2).

2.3.6 Trench Locations

Figure 1-3 shows the locations of trenches proposed as part of this sampling plan. These trenches will be excavated to determine if filled drainages are presently acting to contain perched seepage or contain volumes of debris, organic material, or otherwise unsuitable soil which must be accounted for as part of the formulation of the disposal cell foundation excavation plan.

GT-2T-83

This trench location is in the coal pile area. The 1954 topographic map indicates the existence of a drainage and a surface drainage pipe in this location. The cut and fill map indicates the presence of 2 ft to 4 ft of fill. Adjacent areas contain up to 14 ft of fill based on information presented on the cut and fill map.

GT-2T-84

This trench location is about 85 ft northeast of Building 412. The map of 1954 topography indicates the presence of a drainage and surface drainage pipe in this area.

GT-2T-85

This trench location is about 80 ft north of the northernmost corner of Building 408. the 1954 topographic map indicates the presence of a drainage and closed depression in this area. Since this location is next to a site road, excavation will take place at the northwest corner of the road. Site development drawings indicate that this area is free of subsurface piping and utilities.

2.4 Sample Collection Methods

Figure 2-4 presents the alphanumeric designation that will be used for all sample identification.

2.4.1 Soil Hydraulics Sample Collection Methods

Sample collection methods will vary depending on the particular test method (see Table 2-1). Disturbed and undisturbed samples will be collected in a continuous manner at each sample area using a hollow-stem auger drilling rig. A minimum of one sample per unit from each of the test areas will be obtained. Sampling methods, sample preservation and shipping, and field descriptions of each unit sampled will be in accordance with ASTM, EPA and COE standards as they apply to each of the test methods being sampled for (ASTM D620, COE EM 1906, EPA SW-846). Undisturbed samples will be sealed with bees wax and packaged to retain moisture and avoid shifting during shipment in their original sample tubes.

2.4.2 Perched Water Investigation and Sampling

Trenches will be excavated to undisturbed soil or a maximum depth of 12 ft. Trench walls should be vertical or as close to vertical as practicable due to sloughing. Personnel shall not enter the trenches for any reason and shall not approach within 2 ft of the edge of the trench

XX - YYZZ

CONSECUTIVE SAMPLE TWO DIGIT
NUMBER FOR A PARTICULAR
BOREHOLE OR TRENCH

TWO DIGIT NUMBER DESIGNATING
HOLE OR TRENCH FROM
WHICH SAMPLE IS OBTAINED

TWO DIGIT ALPHA DESIGNATION
INDICATING TYPE OF SAMPLE
SUCH AS : SB - SPLIT BARREL
ST - SHELBY TUBE
CS - CALIFORNIA SAMPLER
BU - BULK SAMPLE
LD - LARGE DIAMETER
(THIN WALL SAMPLE)

EXPLANATION OF SAMPLE DESIGNATION SYSTEM

FIGURE 2-4

REPORT NO.:	DOE/OR/21548-164	EXHIBIT NO.:	A/PI/194/1091
ORIGINATOR	JDC	DRAWN BY:	GLN
		DATE:	10/91

excavation. Excavated materials will be placed adjacent to the excavation for examination by the Project Management Contractor (PMC) field geologist or geotechnical engineer.

Excavated soils must be replaced in the same order as removed. Site restoration will be in accordance with Section 2.6 of this sampling plan.

Soil and seepage water encountered during trenching may be sampled for waste characteristics as deemed necessary by environmental safety and health (ES&H) personnel. Water samples will follow collection protocols for groundwater samples. Samples will be obtained from the backhoe bucket or by dipping from the ground surface using a ladle with an extension handle. Soil samples will be obtained from the backhoe bucket. All samples obtained from the backhoe bucket will be removed with minimal contact of the bucket walls. A total of four water samples and 10 soil samples, including duplicates, is planned. Soil and water samples will be analyzed for the constituents listed in Table 2-4.

2.5 Sample Shipment and Chain of Custody

Chain of custody and sample shipping will follow Weldon Spring Site Remedial Action Project (WSSRAP) standard operating procedures ES&H 4.1.2s, RC-17s, and RC-19s as applicable. All samples taken within the boundary of the WSS will be considered potentially contaminated and treated accordingly. Samples will be checked for radioactive contamination before being released to the laboratory. After the completion of the testing program, all contaminated samples will be returned to the Weldon Spring site (WSS).

2.6 Borehole, Excavation and Trench Abandonment

In order to avoid compromising soil integrity due to investigation disturbance, the following abandonment requirements will be followed for all boreholes, trenches, and excavations.

After sampling has been completed, all boreholes will be abandoned by tremie placing of a high solids bentonite based grout. Grout will be mixed and placed through a mud pump and tremied under positive pressure to the bottom of the hole. The ratio of clay grout to fresh potable water must achieve a weight of at least 9.4 lbs/gal as measured with an approved mud weight measuring device in the field (MKF and JEG 1991b).

TABLE 2-4 Water and Soil Sample Analytes

Media	Analytes
Water	HSL Metals PCBs PAHs Nitroaromatics ^(a) Uranium (total)
Soil	HSL Metals PCBs PAHs Nitroaromatics U-238 Ra-226 Th-230 Th-232

^(a) 1,3,5-trinitrotoluene, 1,3-dinitrotoluene, nitrobenzene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, 2,3,6-trinitrotoluene.

Any borehole or trench not backfilled immediately after sampling will be either covered by the drill rig tools or barricaded with tape and traffic barricades.

Excavations will be backfilled with suitable low permeability excavated material and finally capped with the original topsoil material. Excavation backfill will be placed in 8 in. lifts and compacted to a minimum of 95% of maximum dry density as determined by ASTM D698 and a moisture content within 2% below to 4% above optimum moisture content. Narrow exploratory trenches in fill will be thoroughly compacted using a backhoe bucket. Shallow trenches excavated in upper portions of undisturbed soils will be backfilled and compacted to the same requirements as stated above for excavations.

2.7 Decontamination

Decontamination of sampling equipment will follow procedure ES&H 4.1.3s. Personal protective equipment (PPE) will be covered in the health and safety plan for each subcontract. All sampling equipment, augers, and other equipment that come into contact with contaminated soils will be decontaminated by high pressure water before each borehole is drilled. The entire drilling rig, or backhoe, will be decontaminated upon arrival on site and upon completion of drilling activities. Interior portions of equipment, such as pumps and hoses that are not accessible for cleaning with a pressure cleaner, will be thoroughly cleaned and flushed with potable water. Decontamination will be performed at the site decontamination pad. Split-spoon, Shelby Tube, or California samplers will be washed with a dispersant and water, rinsed with potable water, and reassembled after each sample is taken.

3 QUALITY ASSURANCE

The quality assurance (QA) plan for drilling, test pits, trenches, sampling, and testing includes all applicable Weldon Spring Site Remedial Action Project (WSSRAP) procedures established in the Weldon Spring *Environmental Quality Assurance Project Plan* (MKF and JEG 1992b) and in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Work will be carried out in accordance with WSSRAP engineering procedures and standard operating procedures (SOPs). Forms required for geotechnical sampling include:

- Chain-of-Custody Form
- Sample seals and tapes
- Field data sheets
- Borehole logs
- Test pit logs
- Geotechnical laboratory testing reports

In addition, geotechnical laboratory testing of soil samples and analytical testing of soil and water samples will be performed in accordance with the subcontractors' quality assurance (QA) program, subject to Project Management Contractor (PMC) review and approval. Testing laboratories providing services under this plan must be approved by the PMC Project Quality Department.

QA during drilling, sampling, test pit excavation, and sampling operations will consist of surveillance and inspection of the drilling and excavating subcontractor. Drilling, excavating, and sample procedures will be established. All soil samples will be labeled immediately after removal from the sampler.

The correlation of sample identification to assigned laboratory tests will be verified at the laboratory upon receipt of each sample. Thorough sample tracking and documentation will be initiated and maintained throughout the testing program. Laboratory test results will be reviewed and approved by an individual other than the person who is performing the test before being submitted to the PMC.

4 HEALTH AND SAFETY

In accordance with CM&O-15a, safety concerns and mitigative measures related to sampling activities carried out under this plan will be identified and documented with task specific safety assessments (TaSSAs) which will be prepared, reviewed, approved, and filed with the Construction, Maintenance and Operations Department on a daily basis before work begins in the controlled area. Safety, industrial hygiene, and health physics personnel will also monitor health and safety conditions during sampling. Health physics personnel will monitor personnel and equipment working in areas of radiological contamination.

Personal protective equipment (PPE) will be worn as required at each sampling location. The requirements are outlined in the WSSRAP *Personnel Protective Equipment Requirements Manual* (MKF and JEG 1992c).

Subcontractors will submit a health and safety plan (HASP) prior to coming on site and their plan will be reviewed and approved by the site safety officer prior to commencing sampling work.

5 DATA DOCUMENTATION

Data documentation will follow Weldon Spring Site Remedial Action Project (WSSRAP) standard operating procedures and the *Project Management Contractor Quality Assurance Program*, Section 4 (MKF and JEG 1992d) relating to Documents and Records. During the course of the geohydrologic sampling, a qualified geological or geotechnical engineer will record the daily activities, following field logbook procedures (procedure ES&H 1.1.4) including:

- Date
- Weather conditions
- All personnel involved
- Chronological record of activities

Borehole and test pit logs will be kept on site and updated as the sampling progresses. These logs will be prepared by a qualified geologist, geological engineer or soils engineer (MKF and JEG 1991b). The following data will be included in each borehole or test pit log:

- Test pit or borehole identification.
- Test pit or borehole location.
- Drilling/sampling method and equipment.
- Drilling or excavating contractor.
- Date of commencement and completion.
- Total depth.
- Depth to water table and bedrock (if applicable).
- Hole diameter or test pit dimensions.
- Standard Penetration Test (SPT) number of blows per 6 in. of advancement.

- Lithologic description of materials and soil classification in accordance with ASTM D2488 (ASTM 1991).
- Munsell color chart number code.
- Sample numbers, depth of sample, and sample interval.
- Length of sample recovered (drilling only).
- Description of sampling method (i.e., number of blows for the standard penetration test - SPT).
- Description of completion operations (i.e., borehole or test pit abandonment operations).
- Borehole or test pit logs will be transmitted to the WSSRAP Project Quality Department in accordance with SQP-9a *Inventory, Validation, and Transfer of QA Records* for retention.

Daily logs maintained by the subcontractors will include the activities performed, personnel involved, locations, time, weather conditions, equipment used, and any problems encountered. A field report will be prepared after each geohydrologic investigation is completed. Geotechnical and hydraulic laboratory testing data will be evaluated by the Project Management Contractor (PMC) and transmitted to the Project Quality Department in accordance with SQP-9a for review and retention as a QA record.

6 REFERENCES

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U.S. Environmental Protection Agency, 1986, "Method 9100, Saturated Hydraulic Conductivity, Saturated Leachate Conductivity, and Intrinsic Permeability" in *Laboratory Manual, Physical/Chemical Methods*, Vol. 1C, "Test Methods for Evaluating Solid Waste," 3rd Ed., SW-846. Office of Solid Waste and Emergency Response. Washington, DC. November, pp. 9100-1 - 9100-57.

Code of Federal Regulations

10 CSR 25-7.264(2)(N)1.A and B. *Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities.*

Procedures

CM&O 15a *Task Specific Safety Assessment*

ES&H 1.1.4s *Logbook Procedure*

ES&H 4.1.2 *Chain of Custody*

ES&H 4.1.3s *Sampling Equipment Decontamination*

SQP 9a *Inventory, Validation, and Transfer of QA Records for Retention*

RC 17s *Packaging, Shipping and Receiving of Radioactive Materials*

RC 19s *Packaging, Shipping and Receiving of Nonradioactive Materials*

APPENDIX A
DOCUMENT HIERARCHY

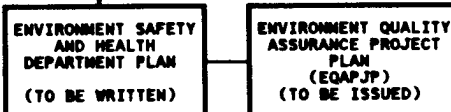
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DE-AC05-86OR21548
APPLICABLE LAWS AND REGULATIONS
APPLICABLE DEPARTMENT OF ENERGY
ORDERS

LEVEL I



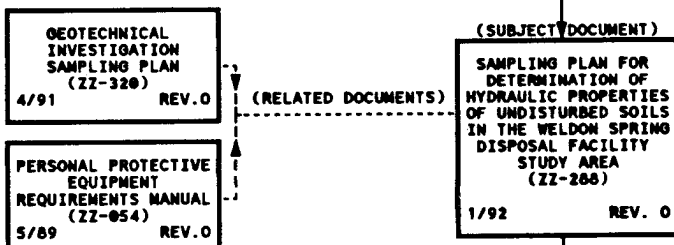
LEVEL II

(PARENT OR AUTHORIZING DOCUMENT)



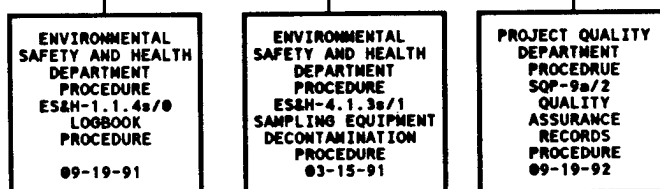
LEVEL III

(SUBJECT DOCUMENT)



LEVEL IV

(SUBORDINATE DOCUMENTS)



LEVEL V

LEVEL 6 DOCUMENTS ARE NOT SHOWN ON THIS CHART (SEE DOCUMENT HIERARCHY REPORT FOR FURTHER INFORMATION.)

LEVEL VI

SAMPLING PLAN FOR DETERMINATION OF HYDRAULIC
PROPERTIES OF UNDISTURBED SOILS IN THE WELDON
SPRING DISPOSAL FACILITY STUDY AREA

APPENDIX A

REPORT NO. DOE/OR/21548-164 EXHIBIT NO.

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10-15-1992













APPENDIX B
BOREHOLE AND TEST PIT LOGS

APPENDIX B - LIST OF FIGURES

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B-1 Geotechnical Boring Log Legend	B-1
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B-6 Geotechnical Boring Log GT-53 (GT-2B53)	B-8
B-7 Geologic Drill Log G-7	B-10
B-8 Trench Log T-6	B-12
B-9 Geologic Drill Log GMW-9	B-13
B-10 Geotechnical Boring Log GT-42	B-15
B-11 Soil Boring Log GT-69	B-17
B-12 Geologic Drill Log G-3	B-19
B-13 Geologic Drill Log G-5	B-22
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GEOTECHNICAL BORING LOG LEGEND

SYMBOLIC LOG

	CLAY		GRAVELLY CLAY
	SILT		CLAYEY GRAVEL
	SAND		SANDY CLAY
	GRAVEL		TOPSOIL
	SILTY CLAY		SHALE
	CLAYEY SILT		CHERTY LIMESTONE

SAMPLER DESIGNATIONS


SS = STANDARD PENETRATION SAMPLER (20" SPLIT SPOON)

SB = CALIFORNIA SAMPLER (3.0" SPLIT BARREL)
X = LINERS COLLECTED

ST = 3.0" SHELBY TUBE

P.P. = POCKET PENETROMETER, UNCONFINED COMPRESSIVE STRENGTH (Tons/Sq.Ft.)

GROUNDWATER MEASUREMENTS

6.5'; 6/9  = DEPTH & DATE OF INITIAL WATER LEVEL MEASUREMENT

2.9'; 6/16  = DEPTH & DATE OF STABILIZED WATER LEVEL MEASUREMENT

COLORS

SOIL & ROCK COLORS FROM MUNSELL SOIL COLOR CHARTS

GEOTECHNICAL BORING LOG LEGEND

FIGURE B-1

REPORT NO.	DOE/OR/21548-164	EXHIBIT NO.	A/PI/179/1091
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		DATE	10/91



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 5

Project Number:
MKE 9423

Hole Number:
GT - 47 (GT-2B47)

Project:
WSSRAP - GT DRILLING

Location:
SEISMIC LINE #6, STA. 1 + 35

Coordinates:
(AEC) 100024.8N 50128.9W

Drilling Contractor:
HANNIBAL TESTING LABORATORIES

Drill Make and Model: CME-55, CONT. FLT. HOLLOW
STEM AUGER; CORE DRILLING: NO WIRELINE

Depth Top of Rock:
35.3 FEET

Depth Casing & Size:
35.5FT 3 1/2" I.D.

Hole Size: AUGER: 7"
CORE: 2.98"

Elevation:
660.3 FT

Angle from Vert. and Bearing:
VERTICAL

Depth Bottom of Hole:
55.5 FEET

Water Level:

Fluid & Additives:
CLEAR WATER

Date Start:
9:20 7/13/88

Date Finish:
1:35 7/15/88

Logger: A. BENFER
P. PATCHIN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-4"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY			
	0	SS	7"	7.13.15			Silty Clay with angular gravel and fine to coarse sand, predominantly pale brown (10YR 6/3), dry, hard CL, contains roots FILL 1
	1.5	01		28			
	2.5	SS	7"	7.7.6			Clayey Silt, mottled, light yellow brown (10YR 6/4), moist, very stiff (2.25), ML LOESS
	4.0	02		13			
5	5.0	ST	27"				Silty Clay, mottled yellow brown (10YR 5/6), very silty and light gray (10YR 7/1) very plastic, moist, stiff (1.75), CL-CH -P.P.=2.0-2.75 - very stiff -P.P.=2.75 - CH FERRELVIEW
	7.5	03					
	7.5	SS	10"	1.3.5			
	9.0	04		8			
10	10.0	ST	6"	Pushed			P.P.=2.25, mostly light gray, trace fine gravel to coarse sand, CH P.P.=2.5 very stiff P.P.=4.1, hard, 10% sand: grading
	12.5	05		30"			
	12.5	SS	17"	2.3.5			
	14.0	06		8			
15	15.0	ST	0"	Pushed			Silty Clay with 25% sand, fine to coarse, mottled light gray (10YR 7/1) and light yellow brown (10YR 6/4) moist, hard (4.0-4.2), CH with MnOx (black) -P.P.=4.5+, hard, trace fine gravel CLAY TILL
	17.0	07		24"			
	17.0	SE	12"	7.12.17			
	19.0	08		29			
20	20.0	SB	12"	3.9.16			
	21.5	09		25			
	22.5	SS	15"	4.7.11			
	24.0	10		18			
25							

GEOTECHNICAL BORING LOG GT-47

FIGURE B-2A

AS INTERPRETED BY
ALAN BENFER, 1991.

REPORT NO.:
DOE/OR/21548-164

EXHIBIT NO.:
A/PI/145/0892

ORIGINATOR:
JDC

DRAWN BY:
SRS

DATE:
8/92



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 2 of 5

Project Number:
MKE 9423

Hole Number:
GT - 47 (GT-2847)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT DRILLING

Location: SEISMIC LINE #6, STA. 1 + 35

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY			
		25.0 SB	18"		5.12.15		-P.P.=4.0-4.5, hard, increasing fine gravel (15%) subrounded
		26.5 11			27		
		27.5 SS	18"		4.5.9		-P.P.=4.2, hard, FeOx nodules, slickensides, fine gravel (angular chert) CLAY TILL
		29.0 12			14		
	30	30.0 SE	6"		3.11.20		Gravelly -P.P.=3.0-4.5 very stiff to hard with slickensides
		31.5 13			31		
		32.5 SS	15"		21.30.20		Clayey Gravel, mostly angular chert up to 1½", clay (30%) strong brown (7.5YR 5/6) CH, moist, medium dense, GC 33.0-34.0 mostly angular limestone ½" to 1" white (7.5YR 8/) RESIDUUM?
		34.0 14			50		
7/13 7/14	35	35.5 SE-15	0"		7.50		35.5'
							Drove 6" to refusal. Auger refusal @ 35.5'. GC as above with 3" chert gravel, sub-rounded with minor strong brown clay (7.5YR 5/6). Refusal at 6:30 a.m. 7/14/88. Hole continued with NQ core barrel. Cored from 35.5' to 55.5'. Core description on sheets 3 through 5.
	40						

GEOTECHNICAL BORING LOG GT-47

FIGURE B-2B

REPORT NO.:
DOE/OR/21548-164

EXHIBIT NO.: A/PI/146/0892

ORIGINATOR: JDC

DRAWN BY: SRS

DATE: 8/92

Project Number:
3840

Boring Number.
GT - 71

Sheet 2 of 2

SOIL BORING LOG

Project: Weldon Springs Site RAP

Location:

Elevations

Drilling Contractor.

Dilling Method and Equipment.

Water Level and Date:

Start

Finish:

- Logger

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 0'-4'-4'- (2)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERNAL	TYPE & NUMBER	RECOVERY			
	25- 27.5	ST 7110	27"			Sandy Clay Lt. brown, moist, plastic, stiff, occasional Fe and Mn staining, chert clasts CL	
	27.5 -29	SS 7111	19"	6-10-15 (25)			
30	30- 31.5	CS 7112	15"	(21-36-20)		Gravelly Clay Lt orange, moist, plastic, stiff, some Mn staining along fractures; angular chert clasts up to 1", up to 30% toward bottom CL	
	32.5 -34	SS 7113	11"	15-15-50/5			
35						RESIDUUM	
						Auger Refusal at 34.5'	
40							
45							
50							
55							

SS = Split Spoon

ST = Shelby tube

CS = California Sampler (3")

SOIL BORING LOG

GT-71

FIGURE B-3B

REPORT NO.:

NO.: **DOE/OR/21548-164**

EXHIBIT NO.:

A/PI/148/0892

ORIGINATOR:

JDC

DRAWN BY:

SRS

DATE:

8/92

100

BORING LOG

Date: 12-17-54
Classified by: C. W. STEVENS

LABORATORY DATA

Date: 12-17-54
Classified by: C. W. STEVENS

Project: **WALTON SPRING**

Location: **WALTON SPRING**

Project: **WALTON SPRING**

Location: **WALTON SPRING**

SAMPLE NUMBER	DATE	DEPTH (FEET)		TYPE OF SAMPLE	DESCRIPTION AND REMARKS	CLASSIFICATION	TESTS	REMARKS
		FROM	TO					
1	12-15-54	0.0	1.5	Soil	Light brown clay, wet & stiff	CL	2.8	CLAY
2	12-15-54	1.5	6.0	Soil	Yellowish clay, wet & hard	CL	2.7	CLAY
3	12-15-54	6.0	10.0	Soil	Dark brown clay, wet & stiff	CL	2.6	CLAY
4	12-15-54	10.0	13.0	Soil	Brown clay, wet & stiff	CL	2.4	CLAY
5	12-15-54	13.0	15.0	Soil	Brown clay, wet & stiff	CL	2.4	CLAY
6	12-15-54	15.0	21.0	Soil	Light brown clay, wet & stiff	CL	2.2	CLAY
7	12-15-54	21.0	24.0	Soil	Light brown clay, wet & stiff	CL	2.4	CLAY
8	12-15-54	24.0	25.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
9	12-15-54	25.0	26.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
10	12-15-54	26.0	31.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
11	12-15-54	31.0	32.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
12	12-15-54	32.0	35.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
13	12-15-54	35.0	37.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
14	12-15-54	37.0	38.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
15	12-15-54	38.0	43.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
16	12-15-54	43.0	45.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
17	12-15-54	45.0	47.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
18	12-15-54	47.0	48.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
19	12-15-54	48.0	51.0	Soil	Be clay, wet & stiff	CL	2.4	CLAY
20	12-15-54	51.0	51.5	Soil	Be clay, wet & stiff	CL	2.4	CLAY
21	12-15-54	51.5	51.5	Soil	Be clay, wet & stiff	CL	2.4	CLAY

FIGURE B-4

REPORT NO:	DOE/OR/21548-164	EXHIBIT NO:	A/PI/144/0892
ORIGINATOR:	IDC	DRAWN BY:	SRS
		DATE:	8/92

LOG OF TEST PIT GT-2T78

- o Location: 50 feet plan west of northwest corner of fence around facility 428
- o Type of excavator: Cat 416 extendable backhoe (new)
- o Start excavation: 4:30 p.m. 07/13/88
- o Finish excavation: 5:05 p.m.
- o Finish backfilling: 8:05 a.m. 07/14/88
- o Finish decontamination: 9:05 a.m.

Depth, Feet		Description
0-1.0	CL	<u>Fill</u> : Silty clay; dark yellowish-brown (10YR4/6); some gravel (1/2" to 2"); dry; medium plasticity; medium stiff.
1.0-4.0	CL	<u>Silty Clay</u> : Yellowish-brown (10YR6/8) and light brownish-gray (10YR6/2); dry; medium plasticity; very stiff.
4.0-6.5	CL	<u>Silty Clay</u> : As above but moist to wet and stiff (possible reworked loess).
6.5-12.0	CH	<u>Silty Clay</u> : Yellowish-brown (10YR5/8) mottled with light brownish-gray (10YR6/2) and brownish-yellow (10YR6/8); wet; high plasticity; very stiff.

Samples Collected

GT-2T78: BU-01A, 4.0'-6.5'

GT-2T78: BU-01B, 4.0'-6.5'

GT-2T78: BU-02A, 6.5'-12'0"

GT-2T78: BU-02B, 6.5'-12'0"

6306j/8

Logged By. H. A. Gale

LOG OF TEST PIT GT-2T78

FIGURE B-5

REPORT NO.	DOE/OR/21548-164	EXHIBIT NO.	A/PI/182/1091
ORIGINATOR	JDC	DRAWN BY	SRS
		DATE	10/91



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

Sheet 1 of 2

Project Number
MKE-9423

Hole Number
GT-53 (GT-2B53)

GEOTECHNICAL BORING LOG

Project: WSSRAP GEOTECH Drilling		Location: Seismic Line #3 Sta. 2+88	
Coordinates: (AEC) 100284N 50781W		Drilling Contractor: Hannibal Testing Laboratories	
Drill Make and Model: CME-55.7" Hollow Stem		Depth Top of Rock: 42.5'	Depth Casing & Size: 42.5', 3 1/2" I.D.
Auger: Coring: NO Wireline		Hole Size: Auger: 7" Core: 2.98"	
Elevation: 655.5 ft.	Angle from Vert. and Bearing: Vertical		Depth Bottom of Hole: 42.5'
Water Level:	Fluid & Additives: None	Date Start: 12:30 8/12/88	Date Finish: 8:35 8/16/88
		Logger: P. Patchin	

ELEVATION DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
	INTERVAL	TYPE & NUMBER	RECOVERY			
0	0	SS	5"	4.3.2		Clayey Silt, dark grayish brown (10YR 5/2), with ang. gravel, roots to .3', very stiff (2.25) damp, ML
	1.5	01		5		
	2.5	ST	16"	Pushed		Silty Clay, light brnsh gry (2.5Y 6/2) with ang. L.S. gravel to 2 1/2", vry stiff (3.5), CL (Gravel at 4.6' for approx. .5')
	4.6	02		25"		
						FILL
5	5.0	SS	15"	3.3.5		Clay, yellowish brn (10YR 5/4) slightly silty, moist, plastic, very stiff (2.25), no gravel, minor MnOx strings and FeOx blebs. CL-CH
	6.5	03		8		
	7.5	ST	19"			Silty Clay, mottled light brnsh gray (2.5Y 6/2) and brnsh yellow (10YR 6/6), MnOx stringers and FeOx blebs abundant, moist, very stiff (2.25) CH
	10.0	04				
10	10.0	SS	16"	3.4.6		-- P.P. = 2.25 CL-CH FERRELVIEW
	11.5	05		10		
	12.5	ST	22"			Clay, mottled lt gry (2.5Y 7/2) and strng brn (7.5YR 5/6), fine ang. grvl and sand (5%), plastic, moist, CH
	15.0	06				
12/88 15/88	15.0	SS	16"	6.9.10		-- Silty Clay, mottled lt gry (10YR 7/1) and brnsh yllw (10YR 6/6) slty (40%) very fine ang. grvl (3%) FeOx blebs and MnOx stringers, damp, CL-CH
	16.5	07		19		
	17.5	ST	21"			Gravelly Clay, brnsh yllw (10YR 6/8) damp with 10% sub-rndd to ang. grvl includ. igneous rx, minor lt gry sandy parts, vry stiff (4.0), CL
	20.0	08				
20	20.0	SS	13"	5.10.12		-- P.P. 4.5 sandy (30%) fine, abund. MnOx, brnsh yllw (10YR 6/6)
	21.5	09		22		
	22.5	SB	12"	7.11.16		-- P.P. = 4.25 2" ang. chert and rounded mafic gravel, 20% fine sand
	24.0	10		27		
25						CLAY TILL

GEOTECHNICAL BORING LOG GT-53 (GT-2B53)

FIGURE B-6A

REPORT NO.	DOE/OR/21548-164	EXHIBIT NO.	A/PI/183/1091
ORIGINATOR	JDC	DRAWN BY	SRS
		DATE	10/91



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

Sheet 2 of 2

Project Number
MKE-9423

Hole Number
GT-53 (GT-2B53)

GEOTECHNICAL BORING LOG

Project: WSSRAP Geotech Drilling

Location: Seismic Line #3 Sta. 2+88

ELEVATION DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-4"-4" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, UCS Group Symbol
	INTERVAL	TYPE & NUMBER	RECOVERY			
25.0	25.0	SS	14"	3.5.6		-- P.P. = 3.25 Sandy, CL
	26.5	11		11		CLAY TILL
	27.5	SB	12"	6.13.30		Silt, mottled light brnsh gry (10YR 6/2) and brnsh yllw (10YR 6/3) slightly clayey, no grvl, dry, stiff, (1.75) minor MnOx and FeOx blebs, ML
	29.0	12				
30	30.0	SS	13"	8.12.12		Silty Clay, mottled yllwsh red (5YR 5/6) and light yllwsh brn (10YR 6/4), 30% silt, 5% fine grvl, FeOx blebs and MnOx stringers (minor), damp, hard (4.5) ML
	31.5	13		24		
	33.3	12	6"	25.50		32.5 - Clayey Gravel, grvl up to 2", chert, angular white, clay (30%) red (2.5YR 4/6) GC
	35.0	SS	12"	9.12.12		-- As above, clay is yllwsh brn (10YR 5/8) and red (2.5YR 4/6) silty, GC
	36.5	15		24		-- As above, approx. 50% clay, very stiff (3.0) moist, GC
	37.5	SE	12"	8.13.25		RESIDUUM
	39.0	16				-- As above, 30% clay some angular limestone, chert is white (2.5Y 8/)
	40.0	SS	14"	12.20.17		
	41.5	17		37		
						T.D. 42.5'
						Auger Refusal at 42.5' @ 1:20 p.m. 8/15/88

GEOTECHNICAL BORING LOG GT-53 (GT-2B53)

FIGURE B-6B

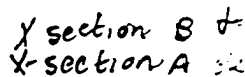
REPORT NO. DOE/OR/21548-164

EXHIBIT NO. A/PV/184/1091

ORIGINATOR JDC

DRAWN BY SRS

DATE 10/91



GEOLOGIC DRILL LOG

G-7

REPORT NO.	DOE/OR/21548-164	EXHIBIT NO.	A/PV188/1091
ORIGINATOR	JDC	DRAWN BY	SRS
		DATE	10/91

GEOLOGIC DRILL LOG										PROJECT	FUSRAP - WELDON SPRING SITE		WELL NO.	250-201	SHEET NO.	2 of 2	DRAWN BY	6-7
SAMPLE TYPE AND NUMBER	SAMPLE DEPTH IN FEET	SAMPLE RECOVERY % OF CORE	SAMPLE RECOVERY % OF CORE	SAMPLE RECOVERY % OF CORE	SAMPLE RECOVERY % OF CORE	SAMPLE RECOVERY % OF CORE	SAMPLE RECOVERY % OF CORE	DATE PRESSURE TESTS				ELEVATION IN FEET	DEPTH IN FEET	CORRECTION IN FEET	SAMPLE LENGTH IN FEET	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, DRAINAGE OF WELLS, ETC.	
								LOG IN FEET	LOG IN FEET	PRESSURE P.S.I.	TIME IN MINUTES							
NIS WIRE CORE	8.0	5.7	71	5.7	4.4	2.5	2.1					596.3	36			LS		
NIS WIRE CORE	9.0	7.6	84	7.6	2.1	1.6	1.5					596.3	37			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					577.7	38			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	39			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	40			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	41			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	42			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	43			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	44			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	45			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	46			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	47			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	48			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	49			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	50			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	51			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	52			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	53			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	54			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	55			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	56			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	57			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	58			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	59			LS		
NIS WIRE CORE	10.0	9.0	90	9.0	5.3	4.77	4.3					569.3	60					

REPORT NO:	DOE/OR/21548-164	EXHIBIT NO:	A/PI/189/1091
ORIGINATOR	JDC	DRAWN BY:	SRS
		DATE	10/91

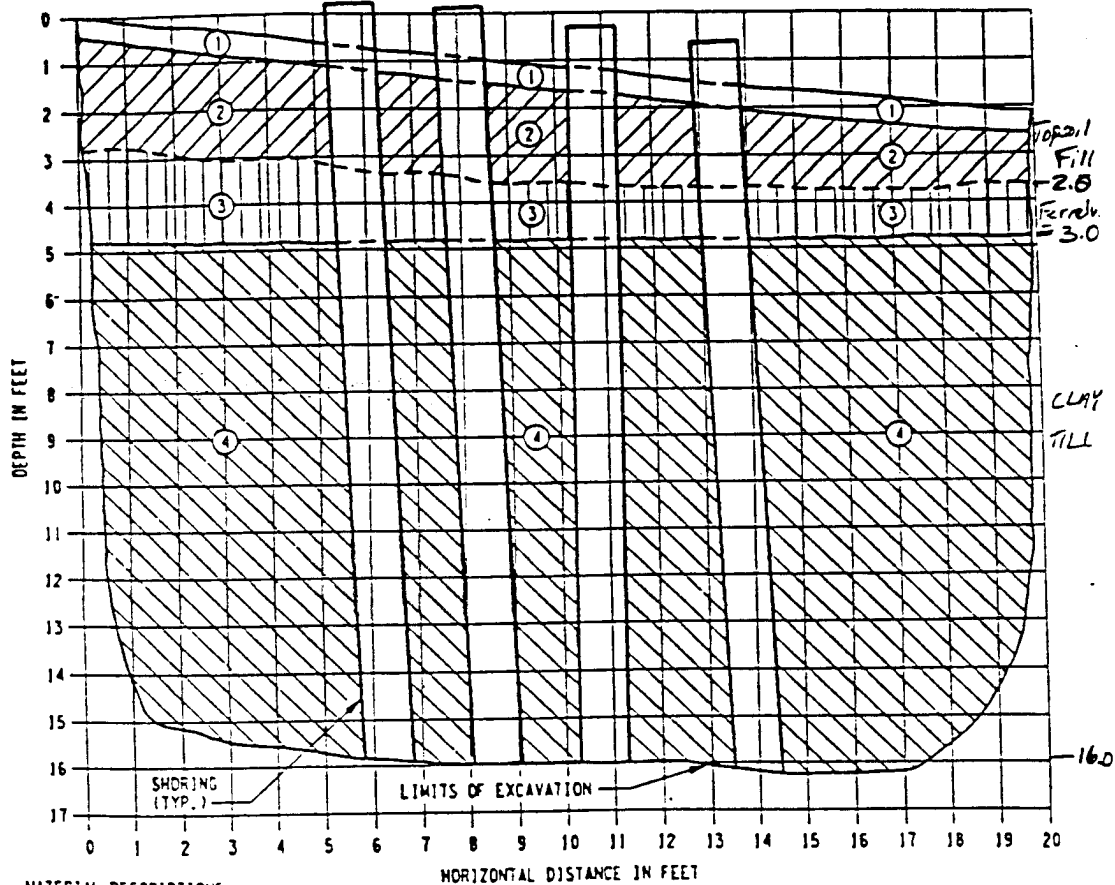


BECHTEL TRENCH LOG

EXCAVATION NO. T-6

PROJECT WELDON SPRING JOB NO. 14501-201 GROUND EL. 638 LOCATION N101.206.5 W50.411.0

DATE EXCAVATED 5-1-86 METHOD OF EXCAVATION BACKHOE DATE BACKFILLED 5-2-86



MATERIAL DESCRIPTIONS:

- ① TOPSOIL - BROWN, CLAYEY SILT, SLIGHTLY SANDY, SOME FINE TO MEDIUM GRAVEL. DRY.
- ② FILL - MOTTLED GRAY AND YELLOW-BROWN, SLIGHTLY SILTY TO SILTY CLAY, WITH SCATTERED FINE TO MEDIUM GRAVEL AND A FEW COBBLES, SLIGHTLY DAMP.
- ③ CLAY (FERRELVUE FORMATION) - MOTTLED GRAY AND YELLOW-BROWN, SILTY CLAY, FEW IRON NODULES AND RARE SAND GRAINS (QUARTZ AND CHERT). DAMP. MODERATELY PLASTIC.
- ④ CLAY TILL - MOTTLED YELLOW-BROWN AND GRAY, VERY SILTY CLAY, SAND CONTENT UP TO 5%, SAND SUBROUND, MEDIUM GRAINED CHERT AND QUARTZ. DAMP TO SLIGHTLY DAMP, VERY LOW PLASTICITY. BLOCKY FRACTURE WITH FRACTURE SURFACES COATED WITH MANGANESE. GRAVEL, COBBLES, AND BOULDERS MAKE UP 10 - 15%. GRAVEL IS SUBANGULAR TO SUBROUNDED, FINE TO COARSE GRAINED. COBBLES AND BOULDERS ARE SUBROUNDED AND UP TO 1 1/2". GRAVEL IS CHERT AND LIMESTONE. COBBLES AND BOULDERS ARE VERY WEATHERED WHITE LIMESTONE AND GRAY CHERT WITH WHITE WEATHERED RIMS.

SIDE SOUTH BEARING N34W EXCAVATOR WEST END CONSTRUCTION CO., INC. GEOLOGIST E. BERGLUND

B-5

BECHTEL TRENCH LOG T-6

FIGURE B-8

REPORT NO	DOE/OR/21548-164	EXHIBIT NO	A/PV/185/1091
ORIGINATOR	JDC	DRAWN BY	SRS
		DATE	10/91

GEOLOGIC DRILL LOG										PROJECT: FUSRAP - WELDON SPRING SITE		JOB NO. 14501-201		SHEET NO. 1 of 2		HOLE NO. GMW-9	
SITE: 300 FT NORTH OF COAL STORAGE AREA										COORDINATES: N101,350 W50,700		HOLE FROM HOLE: 90		BEARING: -			
DATE: 6/25/86		COMPLETED: 7/16/86		DRILLER: GEOTECHNOLOGY INC. KURT JAEGER		DRILL MAKE AND MODEL: CME 45/CME 750		HOLE SIZE: 6 3/4"		OVERBURDEN FT: 20.5		HOLE FT: 33.5		TOTAL DEPTH: 54.0'			
CORE RECOVERY: 77%				CORE BOXES: 2		SAMPLES: 5		CL. TOP OF CASING: -		BONDING CL.: 636.7		DEPTH/VEL. BONDING WATER: 39.0/597.7		DEPTH/VEL. TOP OF ROCK: 20.5 FT/666.2			
SAMPLE BARRED WEIGHT/TALL: 140 LBS/30 IN				CASING LEFT IN HOLE/DIA/LENGTH: 2 7/8"				LOGGED BY: J.E. KAISER/E. BERGLUND									
SAMPLE TYPE AND DIAMETER	SAMPLE DEPTH (FEET) CORE ADJ.	SAMPLE DEPTH (FEET) CORE IN CASING	SAMPLE WEIGHT (LBS)	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	GRAPING LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CORROSION OF DRILLING ETC.				
					LOSS IN 15" CAP	PER PRESSURE IN 15" CAP	TIME IN MINUTES										
6" HSA								636.7	0			0 TO 0.5 FT SILTY CLAY (CL). BLACK (N1) LOW PLASTICITY. MOIST. ORGANICS.	0-20.5 FT DRILLED WITH 6 IN CD HOLE - LOW STEM AUGERS USING CENTER PLUG.				
SS	18"	11"	10	3	4	6		636.2	0.5			0.5 TO 11.5 FT SILTY CLAY: LIGHT BROWN (5YR 5/6) TO RED BROWN (10R 4/6) LOW PLASTICITY. SOFT. MOIST. MOTTLED. LOCALLY LIGHT GRAY (N7) SILTY CLAY LENSES OCCASIONAL LIMESTONE FRAGMENTS. SOME BLACK OXIDE (N1) STAINING.					
6" HSA									5								
SS	18"	16"	23	5	10	13											
6" HSA																	
SS	24"	20"	83					625.2	1.5			11.5 TO 20.5 FT GRAVELLY CLAY (GC): LIGHT REDDISH BROWN (10R 4/6) REDDISH BROWN (10R 3/4). MEDIUM TO HIGH PLASTICITY. STIFF. LOCALLY, LIMESTONE AND CHERT FRAGMENTS (ANGULAR, GENERALLY 1/2" AVG.) MOTTLED. MOIST. 15 FT BECOMING REDDISH BROWN.	0 TO 10.0 FT BORE-HOLE WAS RADIOLOGICALLY LOGGED BY EBERLINE ANALYTICAL CORPORATION.				
SS	18"	18"	39	6	17	22							11.5 FT: SHELBY TUBE				
6" HSA																	
SS	5"	5"	50	50/5	-	-						CLAY TILL	20.5 FT AUGER REFUSAL. 20.5 FT PERFORMED INTERFACE PERMEABILITY TEST AT 5 GPM.				
								616.2	20.5			20.5 TO 26.5 FT LIMESTONE, YELLOWISH ORANGE (10YR 6/6), DECOMPOSED, SOFT TO MODERATELY HARD, WITH LIGHT GRAY (N7) HARD CHERT INTERBEDS AND NODULES, YELLOWISH ORANGE (10YR 6/6) CLAY SEAMS WITH ANGULAR CHERT GRAVEL.	BURLINGTON/KEOKUK F3				
NX2	9'	3.3'	37%									26.5 TO 29.0 FT LIMESTONE, LIGHT GRAY (N5), MODERATELY WEATHERED, HORIZONTALLY FRACTURED, WITH FEW INTERBEDS OF LIGHT GRAY (N7), HARD CHERT, UP TO 3 INCHES THICK, SOME SOLUTION PITS <1/8 INCH DIAMETER.	20.5 TO 54.0 FT CORED WITH NX2 WIRELINE DIAMOND IMPREGNATED CORE BIT USING WATER.				
												29.0 TO 29.0 FT BOX CHERT IN CORE.					
								610.2	26.5			29.0 TO 54.0 FT LIMESTONE, YELLOWISH BROWN (10YR 6/4), WEATHERED TO LOCALLY DECOMPOSED, HORIZONTALLY FRACTURED, WITH LIGHT GRAY (N7), HARD CHERT INTERBEDS, FILLED VOIDS, AND NODULES.					
								607.7	29			29.0 TO 33.0 FT CORE IS BOX CHERT.					
NX2	10'	2.0'	20%					601.7	35								

SS=SPUD. SPOON STIMULATED TUBE. PRODUCTION PARTITION DRILLER. REASONED BY STEM AUGER.

300 FT NORTH OF COAL STORAGE AREA

HOLE NO. GMW-9

GEOLOGIC DRILL LOG GMW-9

FIGURE B-9A

REPORT NO.: DOE/OR/21548-164		EXHIBIT NO.: A/PI/149/0892	
ORIGINATOR: JDC	DRAWN BY: SRS	DATE: 8/92	

GEOLOGIC DRILL LOG										PROJECT	JOB NO.	SHEET NO.	HOLE NO.																				
										FUSRAP - WELDON SPRING SITE	MSOI-201	2 of 2	GMW-9																				
SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE LENGTH CORRECTION	SAMPLE RECOVERY CORRECTION	SAMPLE LOSS %	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	BORING LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.																				
					LOSS IN SPAL	PRESSURE P.S.F.	TIME IN MINUTES																										
								604.7	35			33.0 TO 43.7 FT DECOMPOSED LIMESTONE WITH CLAY SEAMS.	6/26/86 <table border="1"> <thead> <tr> <th>RUN</th> <th>AP (FT)</th> <th>LP (FT)</th> <th>ROQ (%)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>0.15</td> <td>0.55</td> <td>39</td> </tr> <tr> <td>2</td> <td>0.25</td> <td>0.45</td> <td>68</td> </tr> <tr> <td>3</td> <td>0.15</td> <td>0.45</td> <td>16</td> </tr> <tr> <td>4</td> <td>40.1</td> <td>0.2</td> <td>0</td> </tr> </tbody> </table>	RUN	AP (FT)	LP (FT)	ROQ (%)	1	0.15	0.55	39	2	0.25	0.45	68	3	0.15	0.45	16	4	40.1	0.2	0
RUN	AP (FT)	LP (FT)	ROQ (%)																														
1	0.15	0.55	39																														
2	0.25	0.45	68																														
3	0.15	0.45	16																														
4	40.1	0.2	0																														
NXB 3"	10'	5.3'		53%					40			43.7 TO 44.7 FT HIGHLY WEATHERED LIMESTONE, CORE IS 70% CHERT																					
									45			44.7 TO 46.5 FT LIGHT GRAY(NG), FRESH LIMESTONE. 45.7 TO 46.0 FT CORE IS 60% CHERT. 46.5 TO 49.0 FT MODERATELY WEATHERED, CORE IS 50% CHERT.																					
NXB 3"	6'	0.6'		10%					50			48.5 FT OPEN FRACTURE, ORIENTED 60° FROM HORIZONTAL, IRON STAINED. 49.0 TO 54.0 FT RECOVERED ONLY PIECES OF CHERT.																					
								582.7	54			BOTTOM OF BORING AT 54.0 FT. REAMED HOLE TO 8-1/2" AND INSTALLED 2 INCH 316L STAINLESS STEEL MONITORING WELL SCREENED FROM 47.6 TO 57.6 FT. AP=AVERAGE LENGTH OF CORE PIECES FROM EACH RUN. LP=LONGEST PIECE OF CORE FROM EACH RUN. ROQ=ROCK QUALITY DESIGNATION FOR EACH RUN.	ALL SOIL AND ROCK COLOR DESCRIPTIONS FROM THE ROCK COLOR CHART, PRINTED BY THE GEOLOGICAL SOCIETY OF AMERICA, 1948.																				
SS/SPLIT SPOON STICKLEBY TUBE OR DEBRIS OR PITCHER OR OTHER								SITE		300 FT. NORTH OF COAL STORAGE AREA		HOLE NO.		GMW-9																			

GEOLOGIC DRILL LOG
GMW-9

FIGURE B-9B

REPORT NO.:	DOE/OR/21548-164	EXHIBIT NO.:	A/PI/150/0892
ORIGINATOR:	JDC	DRAWN BY:	SRS
		DATE:	8/92

MORRISON-KNUDSEN ENGINEERS, INC. <small>A MORRISON KNUDSEN COMPANY</small>						Sheet <u>1</u> of <u>5</u>	
GEOTECHNICAL BORING LOG						Project Number: MKE 9423	
Project: WSSRAP GT DRILLING						Location: INTERSECTION SEISMIC LINES 3 & 8	
Coordinates: (AEC) 101206.ON 50804.6W						Drilling Contractor: HANNIBAL TESTING LABS	
Drill Make and Model: CME-55, 7" HOLLOW STEM				Depth Top of Rock: 37.0	Depth Casing & Size: 7" AUGER 35.0	Hole Size: 7"/2.98"	
AUGER: CORE NO WIRELINE				Angle from Vert. and Bearing: VERTICAL		Depth Bottom of Hole: 57.0 FT.	
Elevation: 648.0 ft.							
Water Level: NONE		Fluid & Additives: CLEAR WATER		Date Start: 8:20 6/21/88	Date Finish: 7:20 6/24/88	Logger: A. BENFER	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			SYMBOLIC LOG	SOIL DESCRIPTION	
		INTERVAL	TYPE & NUMBER	RECOVERY			STANDARD PENETRATION TEST RESULTS
							6"-5"-5" (N)
	.5	SS			5.8.12	Silty Clay, pinkish gray (7.5YR 6/2) dry, hard (4.5+) CL contains roots Mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1). P.P. = 4.5+	
	2.0	01	1"		20		
	2.0	SS			8.10.13		
	3.5	02	12"		23		
5	4.5	SS		1"	5.8.7	Very silty Silty Clay, mottled yellow brown (10 YR 5/6) and light gray (10YR 7/1) moist, stiff (1.8) with trace of gravel (5%)	
	6.0	03			15		
	7.0	SS		6"	4.5.6	CLAY TILL -P.P. = 4.5+ hard, with MnOx (black) and sandstone cobble -P.P. = 4.5+ with sand (10%) and fine gravel (15%) -P.P. = 3.7 very stiff -P.P. = 4.5+, hard -P.P. = 4.5+ Silty Clay, sandy (fine 20%), gravelly, weathered limestone (2.5Y 7/6) dry, hard. -P.P. = 4.0 very stiff, yellow brown (10YR 6/6) subrounded sand (20%) and fine gravel (5%) MnOx (black)	
	8.5	04			11		
10	9.5	ST		28"			
	12.0						
	12.0	SS			3.6.11		
	13.5	06	12"		17		
15	14.5	SS			3.6.9		
	16.0	07	10"		15		
	17.0	SB			10.23.25		
	18.5	08	12"		37		
20	19.5	SS			5.15.23		
	21.0	09	2"		38		
	22.0	SS			7.7.11		
	23.5	10	13"		18		
25	24.5	SB			13.23.25		

GEOTECHNICAL BORING LOG
GT-42

FIGURE B-10A

REPORT NO. DOE/OR/21548-164	EXHIBIT NO. A/PV/186/1091
ORIGINATOR JDC	DRAWN BY SRS
	DATE 10/91



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

Sheet 2 of 5

Project Number:

MKE 9423

Hole Number

GT - 42 (GT-2B42)

GEOTECHNICAL BORING LOG

Project:

WSSRAP GT DRILLING

Location:

INTERSECTION SEISMIC LINES 3 & 8

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY			
		26.0	11	12"	37		- P.P. = 4.0
		27.0	SS		4.5.9		
		28.5	12	20"	14		- P.P. = 2.5 - 3.5 with stringers of CaCO ₃ (white), subrounded gravel
30		29.5	SS		3.20.27		Silty Clay, Sandy & gravelly (20%) hard lt. yellow
		31.0	13	0	47		brown (2.5Y 6/4) Cl
							Gravel (Chert), clayey (20%), red (10R 5/6), and light gray, (10YR 7/1), dry, dense. GC.
							Chert - RESIDUUM
							heavy gravel 33.5'
							softer at 34' - layered
							auger refusal at 35.0'. Switched to 3" roller bit with water.
							Chert, red clay and minor limestone
							Boring continued with NQ core, 37.0' to 57.0', pages 3-5.

GEOTECHNICAL BORING LOG GT-42

FIGURE B-10B

REPORT NO. DOE/OR/21548-164

EXHIBIT NO.

A/PV/187/1091

ORIGINATOR

JDC

DRAWN BY

SRS

DATE

10/91



MORRISON KNUDSEN CORPORATION
ENVIRONMENTAL SERVICES GROUP

SOIL BORING LOG

Sheet 1 of 2

Project Number:
3840

Hole Number:
GT-69

Project: Weldon Springs Site Remedial Action Project		Location: 200' NW of Bldg. 109, at foot of slope	
Coordinates: (AEC) N 01092.9, W 50327.1		Drilling Contractor: Geotechnology Services, Inc.	
Drill Make and Model: CME 750, ATV mounted		Depth Top of Rock: 31.5	Depth Casing & Size: --
Elevation: 667.1		Angle from Vert. and Bearing: Vertical	
Water Level: Dry		Date Start: 4/08/91 15:00	
Fluid & Additives: None		Date Finish: 4/11/91 9:00	
		Logger: E. Rennat	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			SYMBOLIC LOG	SOIL DESCRIPTION
		INTERVAL	TYPE & NUMBER	RECOVERY		
						Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
						Silty Clay Mottled lt. to med. brown and lt. gray, moist, medium stiff, plastic, occasional Fe and Mn staining; Dk brown organics near top CL
	2.5-4	SS 6901	14"	1-4-5 (9)		
5	5-7.5	ST 6902	15"			
	7.5-9	SS 6903	18"	2-7-10 (17)		
10	10-12.5	ST 6904	28"			
	12.5-14	SS 6905	18"	3-10-15 (25)		
15	15-17.5	ST 6906	24"			
	17.5-19	SS 6907	18"	6-14-20 (34)		
20	20-22.5	ST 6908	27"			
	22.5-24	SS 6909	19"	6-11-25 (40)		
25						

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3')

SOIL BORING LOG
GT-69

FIGURE B-11A

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/151/0892
ORIGINATOR: JDC	DRAWN BY: SRS
	DATE: 8/92

SOIL BORING LOG

Project: Weldon Springs Site RAP Location: _____
 Elevation: _____ Drilling Contractor: _____
 Drilling Method and Equipment: _____
 Water Level and Date: _____ Start: _____ Finish: _____ Logger: _____

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY			
	25-26.5	CS	6910	12"	(52-41-31)		(cont'd)
	27.5-29	SS	6911	17"	3-20-18 (38)		- orange-brown color, 50% chert gravel, occasional calcite encrustation GC - CL
30	30	CS	--	.2"	(100/1")		
							RESIDUUM
							Auger Refusal at 31.5'
35							
40							
45							
50							
55							

SS = Split Spoon ST = Shelby Tube CS = California Sampler (3")

SOIL BORING LOG
GT-69

FIGURE B-11B

REPORT NO.: **DOE/OR/21548-164** EXHIBIT NO.: **A/PI/152/0892**
 ORIGINATOR: **JDC** DRAWN BY: **SRS** DATE: **8/92**

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
NORTHWEST OF COAL STORAGE AREA										FUSRAP - MELDON SPRING SITE		14501-201		1 OF 3		G-3	
SITE										COORDINATES				ANGLE FROM HORIZ.		BEARING	
NORTHWEST OF COAL STORAGE AREA										N101,195.3 W50,948.6				90		-	
BEGIN		COMPLETED		DRILLER		DRILL MAKE AND MODEL		HOLE SIZE		OVERCABLE INCH (FT.)		ROCK (FT.)		TOTAL DEPTH			
2/7/86		2/11/86		TONY CALTRY BROCKE ENGINEERING		ONE-55 ATV		6 1/4" 3		54.6		33.6		88.2 FT			
CORE RECOVERY (FT./%)				CORE BOXES		SAMPLES		EL. TOP OF CASING		SAMPLING EL.		DEPTH/ELL. GROUND WATER		DEPTH/ELL. TOP OF ROCK			
30.5/91				4		11		-		654.0		65.55 FT/588.45		54.6 FT/599.4			
SAMPLE HAMMER WEIGHT/FALL				CASING LEFT IN HOLE - DIA./LENGTH				LOGGED BY:									
140 LBS/30 IN				NONE				LAWRENCE YOUNG									
SAMPLE TYPE AND DIAMETER	SAMPLER ADVANCE LENGTH (IN)	SAMPLER RECOVERY (IN)	SAMPLER LOSS (IN)	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	GRAPHIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.			
					LOSS	S.P.H.	PRESSURE (P.S.I.)	TIME IN MINUTES									
									654.0	0							
									653.5	0.5			0-0.5 FT GRAVEL, LIGHT GRAY (N7), LIME-STONE.	0-54.6 FT DRILLED WITH 6 1/4 IN OD HOLE - LOW STEM AUGERS.			
									650.0	4			0.5-4.0 FT CLAYEY SILT, BLACK (N1), SOFT, MOIST, ORGANIC DEBRIS. <i>Fill</i>				
													4.0-42.0 FT CLAYEY SILT, MODERATE BROWN (5YR 4/4), MOIST, VERT STIFF, TRACE CHERT GRAVEL. <i>Ferrelview?</i>				
SS 2"	18"	18"	17	4	6	11				5		1					
SS 2"	18"	18"	16	4	7	9				10		2					
SS 2"	18"	18"	22	5	9	13				15		3					
SS 2"	18"	18"	26	7	10	16				20		4					
SS 2"	18"	18"	33	14	15	18				25		5					
SS 2"	18"	18"	28	7	13	15				30		6					
									619.0	35				DRIVING COBBLE.			

UNITS INTERPRETED BY
D. E. CONOVER, JULY 1992.

GEOLOGIC DRILL LOG G-3

FIGURE B-12A

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/153/0892
ORIGINATOR: JDC	DRAWN BY: SRS
DATE: 8/92	

GEOLOGIC DRILL LOG										PROJECT: FUSRAP - WELDON SPRING SITE		JOB NO. M504-201		SHEET NO. 2 of 3		HOLE NO. G-3	
SAMPLE TYPE AND SAMPLER	SAMPLE DEPTH (FEET)	SAMPLE ID	SAMPLE WEIGHT (LBS)	WATER PRESSURE TESTS				ELEVATION (FEET)	DEPTH (FEET)	GRAPIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.				
				LOG #	W.P.	W.P.	W.P.										
SS 2"	18"	18"	23	15	18	21		612.0	35		7	Ferrelview?	BOREHOLE WAS RADIOLOGICALLY LOGGED BY EBERLINE ANALYTICAL CORPORATION PRIOR TO CORING. SAMPLER REFUSAL. BURKINGTON/REDDER FM.				
SS 2"	18"	15"	39	15	18	21			40		8						
SS 2"	18"	14"	88	23	48	40			42		9	42.0-54.6 FT SILT AND GRAVEL, PALE REDDISH BROWN (10YR 5/4) TO MODERATE REDDISH BROWN (10YR 6/6), MOIST, STIFF, SILT AND ANGULAR CHERT GRAVEL					
SS 2"	14"	13"	70	14	20	50/2"			45		10	Clay or Basal Till					
SS 2"	14"	13"	70	14	20	50/2"			50		10						
SS 2"	14"	13"	70	14	20	50/2"			55		10						
NO CORE	8.4' 6.7'	80		23.1	5	4		599.4	55		11	54.6-63.0 FT LIMESTONE, DARK YELLOWISH ORANGE (10YR 6/6) TO LIGHT GRAY (N7), MEDIUM SOFT TO MEDIUM HARD, EXTREMELY WEATHERED, HORIZONTALLY FRACTURED, IRON STAINED, FRACTURES FILLED WITH SILT AND CLAY, PLANAR-ROUGH SURFACES, OCCASIONAL STYLOLITES AND THIN (0.1 TO 0.2 FT) CHERT LAYERS.	54.6-88.2 FT DRILLED WITH NO DIAMOND CORING USING WATER. RUN #1 RCD = 71Z AP = 0.4 FT LP = 0.75 FT 2/11/86 RUN #2 RCD = 51Z AP = 0.3 FT LP = 0.65 FT RUN #3 RCD = 72Z AP = 0.5 FT LP = 1.0 FT				
NO CORE	8.5' 8.0'	94		25.0	10	9		591.0	60		12	63.0-80.5 FT LIMESTONE, LIGHT GRAY (N7), MEDIUM HARD, MODERATELY WEATHERED, WITH DARK YELLOWISH BROWN (10YR 4/2) HIGHLY TO MODERATELY WEATHERED, SOFT ZONES 0.1 TO 0.8 FT THICK, HORIZONTALLY FRACTURED.					
NO CORE	6.7' 6.7'	100		26.3	15	7			63		13						
NO CORE	6.7' 6.7'	100						579.0	65		14						
SAMPLER SPIN ON STEEL TUBING, PROBING PAPER ON BOTTOM										NORTHWEST OF COAL STORAGE AREA		HOLE NO. G-3					

GEOLOGIC DRILL LOG G-3

UNITS INTERPRETED BY
D. E. CONOVER, JULY 1992.

FIGURE B-12B

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/154/0892
ORIGINATOR: JDC	DRAWN BY: SRS
DATE: 8/92	

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
										FLUSRAP - WELDON SPRING SITE		MSO-201		3 of 3		G-3	
SAMPLE TYPE AND DIAMETER	FACIES SYMBOL (FACIES CODE RUN)	SAMPLE RECOVERY (CORE RECOVERY)	SAMPLE LENGTH	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	BORING LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, DIAMETER OF DRILLING, ETC.			
					TIME IN MINUTES	PRESSURE P.S.I.	TEMP. IN °F.	TIME IN MINUTES									
									575.0	75							
NO CORE		80.0-89.1'		91					573.5	80.5			80.5-88.2 FT. LIMESTONE, MEDIUM LIGHT GRAY (MG), MEDIUM HARD, SLIGHTLY WEATHERED, HEALED HORIZONTAL FRACTURES FILLED WITH CALCITE, STYLOLITES.	RUN #4 ROD = 80X AP = 6.4 FT LP = 1.0 FT			
									565.8	88.2			BOTTOM OF BORING AT 88.2. BORING GROUTED TO SURFACE ON 2/11/86.	45 FT. OF 4 INCH PVC CASING LOST IN THE HOLE. ROD-ROCK QUALITY DESIGNATION FOR EACH RUN. AP-AVERAGE LENGTH OF CORE PIECES. LP-LONGEST PIECE OF CORE FROM EACH RUN. ALL SOIL AND ROCK COLOR DESCRIPTIONS FROM THE ROCK COLOR CHART PRINTED BY THE GEOLOGICAL SOCIETY OF AMERICA.			
SLIGHT SPIN STRENGTH TEST (PROVISIONAL TESTS)										NORTHWEST OF COAL STORAGE AREA					HOLE NO. G-3		

GEOLOGIC DRILL LOG
G-3

FIGURE B-12C

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/155/0892
ORIGINATOR: JDC	DRAWN BY: SRS
DATE: 8/92	

GEOLOGIC DRILL LOG										PROJECT: FUSRAP - WELDON SPRING SITE		JOB NO. 14501-201		SHEET NO. 1 of 2		HOLE NO. G-5	
SITE: ADJACENT TO ASH DISCHARGE LINE										COORDINATES: N100,650 W51,250		SAMPLE FROM HORIZ. 90		BLANK			
BEGIN: 7/8/86		COMPLETED: 8/4/86		DRILLER: GEOTECHNOLOGY KURT JAEGER		DRILL MAKE AND MODEL: ONE-55		HOLE SIZE: 6 3/8		OVERBURDEN FT: 40.0		BENCH FT: 33.0		TOTAL DEPTH: 73.0			
CORE RECOVERY: 1.70				CORE BOXES: 3		SAMPLES: 8		EL. TOP OF CASING: -		ORIGINE CL: 635.9		DEPTH OF ORIGIN: 30.0/506.0		DEPTH TO TOP OF BENCH: 40.0/506.9			
SAMPLE NUMBER WEIGHT/FULL: 140 LBS/30 IN				CASING LEFT IN HOLE: NONE				LOGGED BY: A. ATKINSON									
SAMPLE TYPE AND NUMBER	SAMPLES ANY OTHER LENGTHS FOR LOGGING	SAMPLE RECOVERY %	SAMPLE WEIGHT	WATER PRESSURE TESTS	ELEVATION	DEPTH	ORIGINE CL	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.							
6" HSA					635.9	0			0 TO 1.0 FT ORGANIC DEBRIS, GRASS, LEAVES, ROOTS, WOOD FRAGMENTS.	0-38.0 FT DRILLED WITH 6IN OD HOL-LOW STEM AUGERS USING CENTER PLUG.							
SS	18"	2.5	26	9	12	14			1.0 TO 7.0 FT CLAY SILT/SILTY CLAY, MOTTLED ORANGE AND GRAY (10YR 5/4), VERY STIFF, MOIST, BLACK FRAGMENTS.								
6" HSA									<i>Ferrelview</i>								
ST	24"	22"															
SS	18"	0	27	10	14	13			7.0 TO 17.0 FT SILTY CLAY, YELLOWISH BROWN (10YR 5.5/5) TO ORANGE (10YR 5/5) AND GRAY (5Y 5/1), VERY STIFF, MOIST, TRACE SAND.	0 TO 10.0 FT. BOREHOLE WAS RADIOLOGICALLY LOGGED BY EBERLINE ANALYTICAL CORPORATION.							
6" HSA									<i>Ferrelview</i>								
SS	18"	3.5	23	9	10	13											
6" HSA																	
SS	18"	18"	17	6	5	8											
6" HSA																	
SS	18"	21"	23	7	13	10			17.0 TO 22.0 FT CLAYEY SILT, GRAYISH ORANGE (10YR 6/3), WITH ORANGE AND BLACK MOTTLEING, VERY STIFF, MOIST.								
6" HSA									<i>Clay Till?</i>								
SS	18"	18"	50	18	23	27			22.0 TO 40.0 FT GRAVELLY CLAY, ORANGE (10YR 5/4 TO 10YR 5/6) TO YELLOW (10YR 6/6) VERY STIFF TO HARD, MOIST, WITH ANGULAR WHITE (NS) TO DARK YELLOWISH ORANGE (10YR 6/6) CHERT.								
6" HSA									<i>Basal Till</i>								
SS	18"	16"	29	13	17	12											
6" HSA																	
SS	18"	11"	50/2"	43	50/2"	-											
6" HSA																	
25-SPIT SPEED ST-DRIFT TUBE, DECREASED PITCH ON CHARTER						SITE: ADJACENT TO ASH DISCHARGE LINE						HOLE NO. G-5					

GEOLOGIC DRILL LOG G-5

FIGURE B-13A

AS INTERPRETED BY
ALAN BENFER, JULY 1992.

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/156/0892
ORIGINATOR: JDC	DRAWN BY: SRS
DATE: 8/92	

GEOLOGIC DRILL LOG										PROJECT	JOB NO.	SHEET NO.	WELL NO.		
										FUSRAP - WELDON SPRING SITE	MSO-20	2 of 2	G-5		
SAMPLE TYPE AND DIAMETER	SAMPLE DEPTH (FEET)	SAMPLE DEPTH (FEET)	SAMPLE DEPTH (FEET)	SAMPLE DEPTH (FEET)	PERCENT CORE RECOVERY	BATCH PRESSURE TESTS			ELEVATION	DEPTH	CORING LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.	
						TIME IN MINUTES	TIME IN MINUTES	TIME IN MINUTES							
6" NGA									600.9	35					
6" NGA									595.9	40			Basal Till	38.0 FT AUGER REFUSAL.	
	3.0	3.0			100								40.0 TO 67.5 FT LIMESTONE, YELLOW TO BEIGE, MODERATELY TO LOCALLY EXTREMELY WEATHERED, MODERATELY HARD, MODERATELY TO EXTREMELY FRACTURED, WHITE TO GRAY, VERY HARD LAYERS AND PATCHES OF CHERT.	38.0 TO 40.0 FT DRILLED WITH 6-IN TRICONE ROLLER BIT AND WATER.	
	5.0	5.0			100								40.0 TO 40.1 FT CLAY SEAM.	40.0 TO 73.0 FT CORED WITH NIS WIRELINE DIAMOND IMPREGNATED BIT USING WATER.	
	4.7	4.7			100								46.6 TO 47.0 FT CLAY SEAM.	BURLINGTON/KEOKUK FM.	
	4.3	3.7			86										
	1.0	0.0			0										
	5.0	3.6			72										
	5.0	4.8			96										
	5.0	5.0			100										
									568.4	70			67.5 TO 73.0 FT LIMESTONE, BLUE-GRAY, FRESH, HARD, CRYSTALLINE, WITH OCCASIONAL LAYERS AND PATCHES OF WHITE AND GRAY CHERT.		
									562.9	73			BOTTOM OF BORING AT 73.0 FT. BORING GROUTED TO SURFACE ON		

Run	AP (FT)	LP (FT)	REC (%)
1	0.1	0.4	21
2	0.2	0.5	33
3	0.2	0.7	22
4	0.2	1.0	49
5	0.2	0.8	34
6	0.2	0.8	63
7	0.3	0.8	72

ROCK-ROCK QUALITY DESIGNATION FOR EACH RUN.
AP=AVERAGE LENGTH OF CORE PIECES
LP=LONGEST PIECE OF CORE FROM EACH RUN.

ALL SOIL AND ROCK COLOR DESCRIPTIONS FROM THE ROCK COLOR CHART PRINTED BY THE GEOLOGICAL SOCIETY OF AMERICA, 1948.

NOTE: SPLIT SPIN ST-14017 TUB. DISCUSSION PARTITION PARTIAL

ADJACENT TO ASH DISCHARGE LINE

WELL NO. G-5

AS INTERPRETED BY
ALAN BENFER, 1992.

GEOLOGIC DRILL LOG G-5

FIGURE B-13B

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/157/0892
ORIGINATOR: JDC	DATE: 8/92
DRAWN BY: SRS	

GEOLOGIC DRILL LOG										PROJECT: FUSRAP - WELDON SPRING SITE		JOB NO. 14501-201		SHEET NO. 1 OF 2		HOLE NO. G-6	
SITE: SOUTH OF ASH POND										COORDINATES: N100,450 W51,150		HOLE FROM HORIZ. 90		BEARING -			
DATE: 6/17/83		COMPLETED: 6/20/86		DRILLER: GEOTECHNOLOGY INC. KURT JAEGER/GEORGE MATTHEWS		DRILL MAKE AND MODEL: CME-45/CME-750		HOLE SIZE: 8-1/4"/3		OVERBURDEN (FT.): 23.5		RIGG (FT.): 43.5		TOTAL DEPTH: 67.0			
CORE RECOVERY: 70% = 23.0/33		CORE BOXES: 4		SAMPLES: 6		EL. TOP OF CASING: -		GROUND EL.: 639.7		DEPTH TO GROUND WATER: 62.77/626.99		DEPTH TO TOP OF ROCK: 23.5/66.2					
SAMPLE WEIGHT: 140 LBS/30 IN		CASING LEFT IN HOLE: NONE		LABORER BY: LAWRENCE YOUNG													
SAMPLE TYPE AND DIAMETER	SAMPLE LENGTH (IN)	SAMPLE WEIGHT (LBS)	SAMPLE RECOVERY (%)	SAMPLE IN OPS	PERCENT CORE RECOVERY	LOSS	WATER PRESSURE TESTS	ELEVATION	DEPTH	DRILLING LOG	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.					
SS 2"	18"	12"	14	4	7	7		639.7	0		0 TO 16.0 FT SILTY CLAY, MODERATE BROWN (SYR 4/4), MOTTLED WITH MEDIUM LIGHT GRAY(N6) SILT LENSES, MOIST, STIFF TO VERY STIFF, TRACE TO SOME FINE GRAVEL (PRIMARILY ICHNOLUS AND METAMORPHIC COMPOSITION), PYROLUSITE STRINGERS.	0-23.5 FT DRILLED WITH 6/4 IN OD HOLE - LOW STEW AUGERS USING CENTER PLUG.					
SS 2"	18"	18"	18	3	8	10			5			0 TO 10.0 FT BORE WAS RADIOLOGICALLY LOGGED BY EBERLINE ANALYTICAL CORPORATION.					
ST 3"	2"	2"	PUSHED	700	PSI.				10			6/20/86					
SS 2"	18"	18"	19	6	8	11			15			MAY BE AFFECTED BY INCOMPLETE BREAKDOWN OF CLEAR MUD.					
ST 3"	2"	0"	PUSHED	1000	PSI.			623.7	16		16.0 TO 23.5 FT GRAVELLY CLAY, DARK YELLOWISH ORANGE (10YR 6/6), MOIST, HARD WITH LIGHT GRAY(N7) ANGULAR CHERT GRAVEL.	SHELBY TUBE STUCK IN HOLE. DROVE SPLIT SPOON SAMPLER INTO TUBE TO RECOVER.					
SS 2"	3"	3"	50+	50/3"					20			23.5 FT AUGER REFUSAL.					
								616.2	23.5		23.5 TO 40.0 FT LIMESTONE, LIGHT BROWNISH GRAY (SYR 6/1), MEDIUM SOFT TO MEDIUM HARD, SEVERELY WEATHERED, WITH MODERATE BROWN(SYR 3/4) CLAY SEAMS, CHERT GRAVEL, SEAMS UP TO 1.5 FT IN THICKNESS, INTERBEDDED WITH SEMI-COMPETENT CHERT LENSES OR LAYERS.	23.5 TO 25.0 FT USED TRICONE ROLLER BIT TO START CORE HOLE.					
NOB	2.0'	2.0'	100						25			25.0 TO 67.0 FT CORED WITH NOB WIRELINE DIAMOND IMPREGNATED BIT USING WATER AND CLEAR MUD.					
NOB WIRELINE CORE	3.0'	1.0'	33						30								
NOB WIRELINE CORE	9.0'	1.3'	14					604.7	35								
30-SPLIT SPOON ST-SHELBY TUBE, PROVISIONAL PARTICLES SORTED										SITE: SOUTH OF ASH POND		HOLE NO. G-6					

GEOLOGIC DRILL LOG G-6

FIGURE B-14A

AS INTERPRETED BY
ALAN BENFER, JULY 1992.

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/158/0892
ORIGINATOR: JDC	DRAWN BY: SRS
DATE: 8/92	

REPORT NO.: DOE/OR/21548-164		EXHIBIT NO.: A/PI/159/0892	
ORIGINATOR: JDC	DRAWN BY: SRS	DATE: 8/92	

WELDON SPRING REMEDIAL ACTION PROJECT						Sheet <u>1</u> of <u>3</u>	
BOREHOLE LOG						Project Number: WP-117	
						Hole Number: GT-61	
Project: Geotechnical Investigation Phase II				Location: Chemical Plant Area, approximately 100' west of building 401			
Coordinates: N.100609.25 W.50679.21 (AEC)				Drilling Contractor: Hannibal Testing Labs			
Drill Make and Model: CME 55, 6 7/8" O.D. H.S. Auger, 3 1/2" I.D.				Depth Top of Rock: 59.5		Depth Casing & Size: 59.5 7" Auger	
Elevation: G.S. 658.13'				Angle from Vert. and Bearing: Vertical		Depth Bottom of Hole: 59.5	
Water Level: None		Fluid & Additives: None		Date Start: 6/20/89		Date Finish: 6/21/89	
						Logger: P. Patchin	

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-4"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY			
0					Augered		D-2.0 Road base rockfill (limestone gravel) <div style="text-align: right;">FILL 2.0</div>
	2.5	SS	01	17"	3-3-4 7		CLAYEY SILT, nonplastic, mottled yellowish brown (10YR 5/4) and very dark grayish brown (10YR 3/2), damp, FeOx and MnOx blebs abundant, (20% clay), siltier at top, stiff (1.75), ML <div style="text-align: right;">LOESS 5.0</div>
5	5.0	ST	02	17"			CLAY, highly plastic, mottled yellowish brown (10YR 5/4) and light gray (10YR 7/2), damp to moist, minor FeOx blebs, stiff (1.5), CH <div style="text-align: right;">FERRELVIEW</div>
	7.5	SS	03	18"	2-3-3 6		CLAY, as above, slightly siltier, pp=1.5, CH with whitish concretion (1cm), no HCl reaction
10	10.0	ST	04	29"			CLAY, as above, increased light gray (10YR 7/2), MnOx stringers and FeOx blebs, pp=2.0, minor fractures, CH <div style="text-align: right;">FERRELVIEW</div>
	12.5	SS	05	18"	2-3-5 8		CLAY, as above, minor very fine gravel <5% slickensides, increased yellowish brown color, pp=2.5, CH
15	15.0	ST	06	29"			SILTY CLAY, slightly plastic, sandy(5%) very fine, mottled yellowish brown (10YR 5/8) and minor light gray (10YR 7/2)(sand), dry to damp, fine gravel(quartz and chert) subangular to subrounded, MnOx stringers abundant, FeOx blebs, hard (4.25), CL
	17.5	SS	07	18"	3-6-8 14		SILTY CLAY, as above with predominant yellowish brown (10YR 5/8); 10% gravel fine to 1 cm, dry, subrounded mafic gravel, hard (>4.5), 5 mm FeOx blebs, CL
20	20.0	ST	08	26"			SILTY CLAY, as above, pp=4.5 <div style="text-align: right;">CLAY TILL</div>
	22.5	SS	09	18"	3-5-9 14		SILTY CLAY, as above, some vertical fractures with leaching, damp to dry, abundant MnOx, some mottling, pp=4.5
25							Sample ST10 on next page

BOREHOLE LOG		
GT-61		
FIGURE B-15A		
REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/160/0892	
ORIGINATOR: JDC	DRAWN BY: SRS	DATE: 8/92

WELDON SPRING REMEDIAL ACTION PROJECT						Sheet <u>2</u> of <u>3</u>		
BOREHOLE LOG						Project Number: WP-117		
Project: Geotechnical Investigation Phase II						Hole Number: GT-61		
SOIL DESCRIPTION								
ELEVATION	DEPTH BELOW SURFACE	INTERVAL	SAMPLE TYPE & NUMBER	RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-4"-6" (N)	SYMBOLIC LOG	Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol	
6/20	25	25.0	ST 10	30"			SILTY CLAY, as above, increased sand (very fine)(20%), minor gravel fine to very fine, dry, pp>4.5, non-plastic, vertical fractures with leaching, CL	
		27.5						
		27.5	SS 11	18"	4-8-11			SILTY CLAY, as above, very silty and sandy (40%), grading to CLAYEY SILT at bottom, vertical fractures leached to light olive gray (5Y 6/2), pp=4.5, dry CL-ML
		29.0			19			
	30							CLAY TILL 30.0
		30.0	ST 12	20"	20			SILTY SAND, very fine grained, brownish yellow (10YR 6/8) dry, hard(>4.5) MnOx streaks, no gravel, SM. CLAY TILL?
		31.6						
		32.5	SS 13	16"	4-7-7			SILTY SANDY CLAY with 10% fine gravel, slightly plastic, damp to moist, yellowish brown(10YR 5/6), with abundant vertical fractures stained with MnOx and leached, very stiff(3.75) CL
		34.0			14			CLAY TILL
		35						
		SB 14	6"	36-50-45			GRAVELLY SAND fine grained, dry to damp, brownish yellow(10YR 6/8). Gravel is coarse grained(CaCO ₃ cemented SS(10%)), very dense, SW. CLAY TILL?	
							Interbedded CLAY, SILT and SAND, mottled yellowish brown(10YR 5/8) and light gray(5Y 7/1). 60% clay is dry to damp slightly plastic with abundant MnOx stringers, vertical fractures, sand is in pockets fine to medium grained(gray), only minor very fine gravel, FeOx nodules, CL	
							As above, more clay(75%), abundant FeOx nodules, damp to dry, minor fine gravel, CL	
							CLAY TILL 42.5	
							CLAY TILL?	
							CLAYEY SILT, mottled light gray(2.5Y 7/2) and yellowish brown(10YR 5/8) with 3cm microcrystalline, angular limestone gravel piece at 42.7'. Silt is nonplastic, damp, with abundant MnOx stringers and FeOx stain, very clayey at top, very stiff(2.5) CL	
							BASAL TILL?	
							GRAVELLY SILT, as above with 30% subangular chert gravel, silt is clayey, light gray(10YR 7/2) with FeOx mottling, damp to dry, dense ML	
							RESIDUUM	
							See next page for sample SS19 description.	

BOREHOLE LOG
GT-61

FIGURE B-15B

REPORT NO.: DOE/OR/21548-164		EXHIBIT NO.: A/PI/161/0892	
ORIGINATOR: JDC	DRAWN BY: SRS	DATE: 8/92	

WELDON SPRING REMEDIAL ACTION PROJECT

Sheet 3 of 3

BOREHOLE LOG

Project Number: WP-117Hole Number: GT-61

Project:

Geotechnical Investigation Phase II

Location:

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY	6"-6"-6" (N)		
55	55.0	SS	7"	6-7-8		CLAYEY GRAVEL, brownish yellow(10YR 6/8) with poorly sorted subangular chert gravel, fine to 4 cm with MnOx dendrites, some very coarse sand (fine gravel) and minor silt, damp to moist, GC	
	56.5	19		15			
						RESIDUUM	
						Auger refusal 59.5	
50						Top of bedrock at 12:55 p.m. 6/21/89 Borehole grouted to surface with Volclay bentonite grout. *Falling Head Test at 51.5', take = 48 oz/10 min After pulling drill pipe determined rock piece at end of pipe. Pipe may have not been seated prop- erly.	

BOREHOLE LOG
GT-61

FIGURE B-15C

REPORT NO.: DOE/OR/21548-164EXHIBIT NO.: A/PI/162/0892ORIGINATOR: JDCDRAWN BY: SRSDATE: 8/92

GEOLOGIC DRILL LOG										PROJECT		JOB NO.		SHEET NO.		HOLE NO.	
EAST OF BLDG. 407										FUSRAP - WELDON SPRING SITE		14501-201		1 of 3		G-8	
COORDINATES										N100,450		W49,900		INCHES FROM HOLE		BLANK	
DATE		COMPLETED		DRILLER		DRILL MAKE AND MODEL		HOLE SIZE		OVERBURDEN FT.		ROCK FT.		TOTAL DEPTH			
6/16/86		6/18/86		GEOTECHNOLOGY INC.		CME-45/CME-750		6-1/4"/3"		30.0		45.0		75.0'			
CORE RECOVERY (%)		CORE BOXES		SAMPLES		CL. TOP OF CASING		GROUND EL.		DEPTH TO GROUND WATER		DEPTH TO TOP OF ROCK					
100/100		5		8		-		655.3		52.0'/603.8		30.0'/625.3					
SAMPLE NUMBER				CASING LEFT IN HOLE (DIA./LENGTH)				LOGGED BY									
140 LBS/30 IN				NONE				LAWRENCE YOUNG									
SAMPLE TYPE AND ORIENT	SAMPLE NUMBER	SAMPLE DEPTH (FT)	SAMPLE DEPTH (IN)	SAMPLE DEPTH (CM)	SAMPLE DEPTH (MM)	WATER PRESSURE (PSI)	WATER TEMPERATURE (°F)	ELEVATION	DEPTH	GRAPIC LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, SAMPLES OF DRILLING, ETC.				
														100	200	300	400
								655.3	0			6' Fill					
								654.8	0.5			0 TO 0.5 FT GRAVEL/MEDIUM GRAY(N5), LIMESTONE, TRACE ORGANIC DEBRIS, ROADBED.	0-30.0 FT DRILLED WITH 6" I.D. HOLES LOW STEEL AUGERS USING CENTER PLUG.				
SS	2'	18"	5'	6	3	3	3	Ferrelview	5			0.5 TO 15.0 FT SILTY CLAY, DARK GREENISH GRAY(SCY 4/1) TO MODERATE YELLOWISH BROWN(10YR 5/4), MOIST, MEDIUM STIFF, TO STIFF, MOTTLED WITH MEDIUM GRAY(N5) SILT LENSES, OXIDIZED ZONES NEAR BOTTOM OF UNIT. Fill 6.0	Grading plan				
												3' Loess - 9.0					
SS	2'	18"	13'	13	2	5	8		10			Loess					
												Ferrelview					
ST	3'	2.0'	2.0'					PUSHED @ 700 PSI					Picks from GT-55				
SS	2'	18"	19'	12	4	5	7		15			15.0 TO 26.0 FT SILTY CLAY, LIGHT BROWN (5YR 5/6), MOIST, VERY STIFF, SOME FINE GRAVEL, PYROLUSITE STRINGERS.	0 TO 10.0 FT BOREHOLE WAS RADIOLOGICALLY LOGGED BY EBERLINE ANALYTICAL CORPORATION.				
SS	2'	18"	21'	17	4	6	11		20								
												Clay fill					
ST	3'	2.0'	2.0'					PUSHED @ 700 PSI									
SS	2'	18"	24'	18	6	7	11		25								
								629.3	26			26.0 TO 30.0 FT GRAVELLY CLAY, LIGHT BROWN(5YR 6/6) TO DARK YELLOWISH ORANGE (10YR 6/6), MOIST, HARD, VERY LIGHT GRAY (N8), MODERATELY WEATHERED, ANGULAR CHERT GRAVEL, TRACE TO SOME FINE-GRAINED SAND.	AUGER REFUSAL AT 30.0 FT. 30.0 TO 75.0 FT. DRILLED WITH NYS DIAMOND IMPREGNATED CORE BIT AND FRESH WATER.				
SS	2'	11"	9'	50+	5	50/	5-1/2"		30			30.0 TO 34.3 FT LIMESTONE, DARK YELLOWISH ORANGE(10YR 4/6), MODERATELY SOFT, SEVERELY WEATHERED, WITH MODERATE BROWN (5YR 3/4), CLAY SEAMS WITH CHERT GRAVEL AND SEMI-COMPETENT CHERT LAYERS.					
								625.3									
NYS WIRE LINE CORE		10.0	9.0	90'				12.1	5	9							
								13.2	10	8							
								1	1	1							
								27%									
								15.5	5	6							
								621.0	34								
								620.3	35								

INTERPRETATION OF UNITS
BY ALAN BENFER, 1989.

GEOLOGIC DRILL LOG G-8

FIGURE B-16A

REPORT NO.:	DOE/OR/21548-164	EXHIBIT NO.:	A/PI/163/0892
ORIGINATOR:	JDC	DRAWN BY:	SRS
		DATE:	8/92

GEOLOGIC DRILL LOG										PROJECT	JOB NO.	SHEET NO.	WELL NO.
										FUSRAP - WELDON SPRING SITE	14501-201	2 OF 3	G-8
SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE (EACH CORE RUN)	SAMPLE RECOVERY (CORE RECOVERY)	SAMPLE LOSS (%)	PERCENT CORE RECOVERY	WATER PRESSURE TESTS			ELEVATION	DEPTH	DRILLING LOG	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON: WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES						
					16.0	10	8	620.3	35			34.3 68.7 FT LIMESTONE, BROWNISH GRAY (5YR 4/1) TO DARK YELLOWISH ORANGE (10YR 4/6), MODERATELY HARD, MODERATELY TO SLIGHTLY WEATHERED, STYLOLITIC, VUGGY. CHERT LAYERS OR MODULES, HORIZONTALLY FRACTURED WITH IRON STAINED AND CLAY-FILLED ROUGH-PLANAR APERTURES.	RUN #2 RCD = 52% AP = 0.3 FT LP = 0.6 FT
								60.3	42			42.0 TO 44.0 FT CLAY FILLED CAVITY.	
NXB WIRE LINE CORE	10.0'	7.7'	77%					61.3	44				
								61.3	45				
								61.3	45				
									50				
NXB WIRE LINE CORE	8.0'	7.6'	95%					58.0	55			52.6 TO 56.0 FT BROKEN ZONE.	6/8/85 RUN #3 RCD = 33% AP = 0.3 FT LP = 0.5 FT
								58.0	55				
NXB WIRE LINE CORE	7.0'	7.0'	100%					58.0	60				RUN #4 RCD = 55% AP = 0.3 FT LP = 0.7 FT
								58.0	60				
NXB WIRE LINE CORE	10.0'	10.0'	100%					586.6	68.7			68.7 TO 75.0 FT LIMESTONE, BROWNISH GRAY (5YR 4/1) TO MEDIUM GRAY (5YR 4/6), HARD SLIGHTLY WEATHERED, CHERT MODULES WITH VUGS IN CHERT.	RUN #5 RCD = 39% AP = 0.3 FT LP = 0.7 FT
								586.6	68.7				
								580.3	75				

35 = SPLIT SPDR. ST. SHELBY TUBE
 IN BIRMINGHAM PORTLAND CEMENT

SITE: EAST OF BLDG. 407
 HOLE NO.: G-8

GEOLOGIC DRILL LOG

G-8

FIGURE B-16B

INTERPRETATION OF UNITS
BY ALAN BENFER, 1989.

REPORT NO.: DOE/OR/21548-164 EXHIBIT NO.: A/PI/164/0892

ORIGINATOR: JDC DRAWN BY: SRS DATE: 8/92

GEOLOGIC DRILL LOG										PROJECT	JOB NO.	SHEET NO.	HOLE NO.	
										FUSRAP - WELDON SPRING SITE	14501-201	3 of 3	G-8	
SAMPLE TYPE AND DIAMETER	SAMPLE ADVANCE LENGTH CORRECTION	SAMPLE RECOVERY CORRECTION	SAMPLE IN OVS	PERCENT CORE RECOVERY	WATER PRESSURE TESTS				ELEVATION	DEPTH	CORRECTION	SAMPLE	DESCRIPTION AND CLASSIFICATION	NOTES ON WATER LEVELS, WATER RETURN, CHARACTER OF DRILLING, ETC.
					LOSS IN G.P.M.	PRESSURE P.S.I.	TIME IN MINUTES							
									580.2	75			BOTTOM OF BORING AT 75.0 FT. BORING GROUTED TO SURFACE ON 6/18/86.	ROD-ROCK QUALITY DESIGNATION FOR EACH RUN. AP-AVERAGE LENGTH OF CORE PIECES LP-LONGEST PIECE OF CORE FROM EACH RUN. ALL SOIL AND ROCK COLOR DESCRIPTIONS FROM THE <u>ROCK COLOR CHART</u> PRINTED BY THE GEOLOGICAL SOCIETY OF AMERICA, 1948.
SS-SPUT SPOON ST-STEEL TUBE BODINSON-PIPTON, OTHER										SITE	EAST OF BLDG. 407			HOLE NO. G-8

INTERPRETATION OF UNITS
BY ALAN BENFER, 1989.

GEOLOGIC DRILL LOG G-8

FIGURE B-16C

REPORT NO.: DOE/OR/21548-164	EXHIBIT NO.: A/PI/165/0892
ORIGINATOR: JDC	DRAWN BY: SRS
DATE: 8/92	



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON KNUDSEN COMPANY

GEOTECHNICAL BORING LOG

Sheet 1 of 5

Project Number:
MKE 9423

Hole Number:
GT-55 (GT-2B55)

Project:
WSSRAP GEOTECH DRILLING

Location:
Approx. 33' E. seismic line #2, Sta. 4+67

Coordinates:
(AEC) 100490N 49937W

Drilling Contractor:
Hannibal Testing Laboratories

Drill Make and Model: CME-55 7" Hollow
Stem Auger; Core: NO Wireline

Depth Top of Rock:
33.0

Depth Casing & Size:
3 1/2" I.D.

Hole Size: 7" Auger
2.98" Core

Elevation:
655.6 ft. G.S.

Angle from Vert. and Bearing:
Vertical

Depth Bottom of Hole:
53.0

Water Level:

Fluid & Additives:
Clear Water

Date Start:

08/19/88

Date Finish:

12:00 08/24/88

Logger: P. Patchin
A. Benfer

ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SYMBOLIC LOG	SOIL DESCRIPTION Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY			
8/19 8/22	0.0	SS			3.7-11		Silt, very dark grayish brown, (10YR 3/2) with angular limestone gravel, roots 0.0-0.2'. Pale yellow (10YR 7/4)) at 1.4', dry. ML FILL
	1.5	01	5"		18		
	2.5	ST		20"			Silt, brown (10YR 5/3), slightly clayey, mottled with gray (10YR 6/1), damp to dry, hard (4.5) ML
	5.0	02					
	5.0	SS		12"	1.3-3		Clayey silt, yellowish brn (10YR 5/6), stiff (1:5), damp, ML FILL 6.0
	6.5	03			6		
	7.5	ST		19"			Silty clay, olive gray (5Y 5/2), moist, stiff (2.0) silt (40%) CL LOESS
	10.0	04					
	10.0	SS		12"	3.6-9		- P.P. = 2.0, less silt, CL-CH 10.0 Silty Clay, mottled - P.P. = 3.0, very stiff, gray (5Y 6/1) and brnsh yellow (10YR 6/8), minor MnOx FERRELVIEW
	11.5	05			15		
15	12.5	ST		25"			Clay, mottled light gray (10YR 7/1) and brownish yellow (10YR 6/6), moist - tid wet, very stiff (2.5), CL-CH FERRELVIEW
	15.0	06					
	15.0	SS			2.4-5		- P.P. = 2.2, trace sand (< 5%), moist
	16.5	07		14"	9		
20	17.5	ST		20"			- P.P. = 2.75, mottled brownish yellow (10YR 6/6) and light gray (10YR 7/1) and black (MnOx). 20.0 10% sand and fine gravel, CL
	20.0	08					
	20.0	SS		18"	4.9-11		Silty clay, sandy (20%) and fine gravel (5%), mottled brownish yellow (10YR 6/6), light gray (10YR 7/1, and black (MnOx), moist, hard (4.5+). CL-CH
	21.5	09			19		
25	22.5	SB		12"	5.9-12		- P.P. = 3.0, very stiff, 20% sand CLAY TILL
	24.0	10			21		

GEOTECHNICAL BORING LOG GT-55

FIGURE B-17A

REPORT NO.:
DOE/OR/21548-164

EXHIBIT NO.:
A/PI/166/0892

ORIGINATOR:
JDC

DRAWN BY:
SRS

DATE:
8/92



MORRISON-KNUDSEN ENGINEERS, INC.
A MORRISON-KNUDSEN COMPANY

Sheet 2 of 5

Project Number
MKE 9423

Hole Number
GT-55 (GT-2B55)

GEOTECHNICAL BORING LOG

Project: WSSRAP GT Drilling

Location: Approx. 33' E. seismic line #2, Sta. 4+67

WSSRAP GT Drilling						SOIL DESCRIPTION	
ELEVATION	DEPTH BELOW SURFACE	SAMPLE			STANDARD PENETRATION TEST RESULTS	SYMBOLIC LOG	Name, Gradation or Plasticity, Particle Size Distribution, Color, Moisture Content, Relative Density or Consistency, Soil Structure, Mineralogy, USCS Group Symbol
		INTERVAL	TYPE & NUMBER	RECOVERY	6"-4"-4" (N)		
		25.0	SS 11	18"	3.5.8 13		Silty Clay, sandy (15%), fine gravel 1/8-1/4" (15%), mottled brownish yellow (10YR 7/6), light gray (10YR 7/1) and black MnOx stringers, moist, very stiff (3.3). CH. FeOx nodules. 27.0
		26.5					
		27.5	SB 12	12"	4.11:16 27		Clay, 15% fine gravel (1/8" chert), mottled, red (10R 5/6), light gray (10YR 7/1) and minor black, moist, very stiff (3.5). CH
		29.0					
30		30.0	SS 13	7"	4.31:30 61		Gravel, (chert), clay matrix (25%) red brown (5YR 5/4), dense. GC. RESIDUUM
		31.5					
		32.5	SS 14	0'	Rods Bouncing		T.D. 33.0 auger refusal 1:40 8/22/88 Switched to NQ core at 33.0', to 53.0', pages 3-5
35							
40							

GEOTECHNICAL BORING LOG GT-55

FIGURE B-17B

REPORT NO.: DOE/OR/21548-164

EXHIBIT NO.: A/P/167/0892

ORIGINATOR: JDC

DRAWN BY: SRS

DATE: 8/92

CHEMICAL PLANT ADMINISTRATIVE RECORD FILE

ARFS FILE # C-202-1

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C-200-202-1.01()	PHASE I CHEMICAL SOIL INVESTIGATION DATA REPORT THE WSCP/WSRP
C-200-202-1.02(r)	RADIOLOGICAL AND CHEMICAL UPTAKE BY EDIBLE PORTIONS OF SELECTED BIOTA AT THE WSS
C-200-202-1.03(r)	AQUIFER CHARACTERISTICS DATA REPORT FOR THE WSCP/WSRP AND VP
C-200-202-1.04	WSSRAP ANNUAL SITE ENVIRONMENTAL REPORT 1989